FLIGHT
and
AIRCRAFT ENGINEER

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The Outlook

Swan Song?

EYEBROWS may be raised by some readers when they see the amount of space we give this week to the Rolls-Royce Eagle. A new piston-engine in 1947! And after studying the details and admiring the unquestionable skill that has gone into the design, they might quite possibly dismiss this engine as a waste of fine effort. It has "all modern conveniences": two-stage two-speed superchargers, direct fuel injection, sleeve valves, and contra-rotating four-bladed airscrews. In 1940, yes, but in 1947?

This reaction would be very natural, but it would be be quite wrong. That the Eagle may well be the last Rolls-Royce high-powered piston engine is undeniable, but that it may quite probably save an awkward situation is equally true. For a beginning it is fitted in the new Westland Wyvern naval aircraft, but that is not likely to be the end of its usefulness.

In some ways it is, perhaps, not an unmixed blessing that progress with jets has been so rapid. The lines of development, somewhat difficult to foresee in the early stages, are now becoming fairly clear: plain jets for very high speeds; airscrew-turbines for high cruising speeds at considerable altitudes; and the compound engine, with its basic possibility for very low fuel consumption, for very long-range reconnaissance or transport.

Those are the lines along which the utilization of the new power plants will probably evolve. Unfortunately, however, each of these brings problems of its own, apart from those related to the power units themselves. High speed at great height is beset with Mach Number difficulties. Pressurization of large cabins has its own particular "headaches." Catering for the gust case at high speeds and great altitudes involves structural and aerodynamic considerations of no mean magnitude.

Apart from these, there are still the power units themselves to be borne in mind. Recent years have shown, with rather unpleasant distinctness, that even in fairly orthodox aircraft it is very easy to run into trouble after a new type has gone into service. It is not unlikely that something of the same sort may happen with the new types of power unit. Until they have been in actual use in the R.A.F., the Navy, and on the air routes for a considerable time, we cannot be certain that no troubles will develop which will call for modifications and cause delay. In the meantime there is a bread-and-butter job to be done, and that is why this journal welcomes the new Rolls-Royce Eagle piston-engine. There is a lot of comfort in the thought that, should the need arise, we have here a power unit which can step into the breech and, if circumstances demand it, can be still further developed in the matter of power output, just as was the Merlin in its time.

So let us lower those eyebrows again.

The Other Extreme

RECENT conferences and meetings have shown that at the other end of the power scale from the Rolls-Royce Eagle there is a great need for a light, cheap, simple engine of some 40 b.h.p. The Ultra Light Aircraft Association has been given encouraging hints from the authorities that the "Permits to Fly" which were in force before the war are likely to be reinstated; financial assistance from the Kemsley Fund is assured; and the very welcome announcement that annual landing cards at £5 each for Government airfields and those controlled by the Aerodrome Owners' Association are available on application to the R.Ae.C. at Londonderry House, will be of great benefit to prospective owners of "ultra-lights." But more important, at least for a start, is the right engine at the right price.

Counting chickens before they are hatched was ever a risky business. The Air Ministry recently cackled about such a chicken in the form of the new air traffic control service. It does not seem to have emerged

from its egg yet, and the egg may still be found to be addled. Similarly, there is hanging over all the fine sentiments expressed in different quarters the dread of the new regulations for private flying which the Whitney Straight Committee is now pondering for the benefit of the Minister of Civil Aviation. If they turn out to be on the lines already reported, all the cheap engines, low landing fees, and permits to fly will be of little avail. So the next thing awaited before one can see how the private flying picture is really forming is the recommendation of the Straight Committee to the Minister of Civil Aviation—and, of course, the action taken upon it by Lord Nathan.

Pennywise

HITHERTO it has been common practice for airline companies to include in the price of air tickets the necessary ground transport between main town office and the airport, and any meals served in the aircraft during the flight. Rumour has it that one or more of the British state-owned corporations are contemplating the possibility of making an extra charge for ground transport and meals.

In the parallel cases of surface transport, train and steamship, it has been the custom for meals to be charged extra on trains and short-distance sea voyages, while in the long-distance liners the meals are included in the price of the ticket.

A reasonable case might be argued for either system, on purely academic grounds, but it is necessary to maintain a sense of proportion. Air fares are so high, and duration of flights so relatively short in relation to surface transport, that in practice the saving to the corporations would be a mere drop in the ocean, and it is certain that it would be far outweighed by the dissatisfaction of passengers. It would be a pity if the goodwill built up by the British airlines where service and courtesy to passengers are concerned should be injured by a step which could not appreciably reduce the deficits of the corporations of which warning has already been given

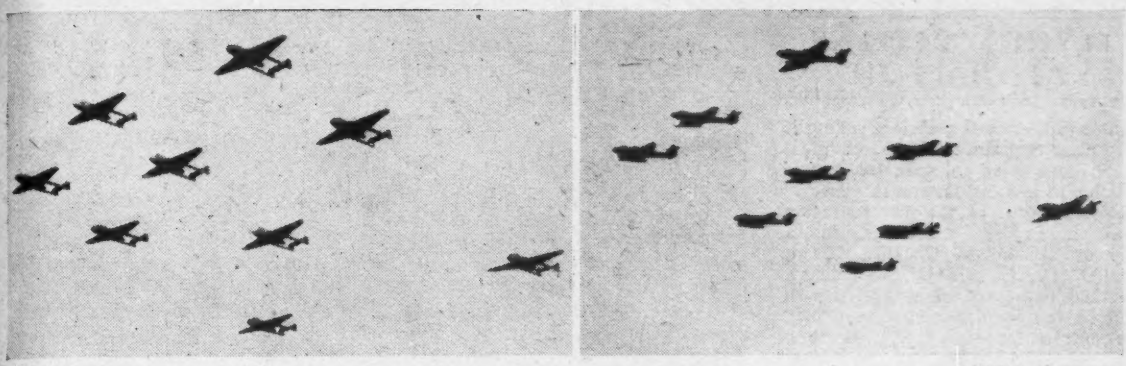
The corporations may have had Government intimation that they must reduce expenses wherever possible, but we would like to suggest that the Government itself can assist in that direction by hastening its relinquishment of priority seats on the air routes. A great deal of money has been wasted in the past by such seats being retained until the last moment, when their cancellation has left little or no possibility for the airline to sell the seats to ordinary passengers.

CONTENTS

Outlook	357
Flying Display at Halton	359
To Geneva by Viking	361
Thornton Engine Laboratory	362
Here and There	364
Wheeled Instruction	366
American Newsletter	367
Rolls-Royce Eagle	a
Eight-Blade Rotol	372
Civil Aviation News	374
Service Aviation	377
Correspondence	379

"Flight" photograph.

AIR CHIEFS AT HALTON: General J. L. Piollet, French Chief of Air Staff, recently visited this country at the invitation of our own C.A.S., Marshal of the Royal Air Force Lord Tedder, with whom he is seen above. They are accompanied by the Secretary of State for Air, Mr. Noel-Baker (left), and the occasion was a flying demonstration by aircraft of the Home Commands. While at Halton, the General also inspected the No. 1 School of Technical Training. The demonstration is described on the next page.



"Flight" photograph.

Jet formations in the fly-past. The Vampires (left) are led by W/C. Balnforth, D.S.O., D.F.C., and the Meteors of No. XI Group by S/L. Wright, D.F.C., D.F.M.

FLYING DISPLAY AT HALTON

Air Attachés of Many Countries See R.A.F. Home Commands Demonstration

IF the importance of an event is proportional to the number of V.I.P.s present, the flying demonstration given by aircraft of the R.A.F. Home Commands at Halton on the evening of April 18th must rank as one of the outstanding, if not the most outstanding, displays since the war.

Originally arranged for March 27th, the occasion of the inspection of No. 1 School of Technical Training at Halton by delegates from the U.S.S.R., this demonstration was a repeat performance, bad weather having severely curtailed the earlier display. A report of the Russian inspection was given in *Flight* of April 10th.

During the afternoon of Friday, April 18th, General J. L. Poillet, Chief of Staff, French Air Forces, inspected the Technical School. Names on the guest list this time included the Prime Minister and Mrs. Attlee, and again the Secretary of State, Mr. Noel-Baker. Sir Henry Tizard and the Fourth Sea Lord were present, and Air Attachés and their staffs representing some 25 countries included four each from America and Russia.

The C.A.S. Lord Tedder and Lady Tedder were present, as were Marshals of the R.A.F. Ellington and Salmond, and Air Chief Marshal Sir J. C. Slessor. The list also again included the A.O.C. in C. Bomber, Fighter, Coastal, Transport, Flying Training, Technical Training, Reserve and Maintenance Commands, and some 35 other Air Marshals.

Word of the display seemed to have got round, at least locally, and the airfield, some adjoining fields and the Wendover-Tring road overlooking the airfield filled up quite early with officers and airmen's families and many other spectators from the general public.

The display itself was well organized and kept well to time. The first event was a fly past commencing at 1730 hours, and led by three Lancasters commanded by F/L. Wheeler, D.F.C., of 44 Squadron. Three Lincolns and three Beaufighters followed to complete Group II. Three Sunderlands forming Group I were to have lead the formations but fog on the South Coast prevented them from taking off.

A fine formation of nine Mosquito night fighters led by S/L. Hardiman, D.F.C., No. 25 Squadron, introduced Group III and five Spitfires commanded by S/L. Parker, of No. 63 Squadron, followed. As the commentator remarked, this was probably the last time Spitfires would be featured in an R.A.F. fly past.

S/L. Arthur, D.F.C., then led across four Hornets of No. 19 Squadron at a speed of about 300 m.p.h. Their tight formation (one in the box) looked particularly impressive.

Jets were next on the list, and two flights of nine and five Meteors respectively roared across at about 400 m.p.h. They appeared to be short nacelle IIIs in the main, and were led by S/L. Wright, D.F.C., D.F.M., of No. XI Group and S/L. Brandt of No. XII Group.

The final fly-past Group was No VI comprising nine Vampires flying at 465 m.p.h. under the command of W/C. Balnforth, D.S.O., D.F.C. Their formation was good and they circled round at very high speed for a second passage over the field.

Visibility in the air was becoming quite poor and

"Flight" photograph.

Many distinguished spectators were present at the flying demonstration. The Prime Minister is here seen with Air Commodore J. F. Titmas, C.B.E., commanding R.A.F. Station Halton, and M. Etlin, French C.A.S.' staff. Another photograph appears opposite.

FLYING DISPLAY AT HALTON

"Flight" photograph.

An outstanding event was the dropping by three Dakotas of paratroopers from No. 1 Parachute Training School.

although there was sufficient ceiling it was clear that the pilots of individual jet fighters were going to have some trouble in keeping Halton in view.

No. 2 event of the demonstration was high-speed aerobatics in a Meteor III by W/C. Bird-Wilson, D.S.O., D.F.C. He did two polished vertical figures of eight and a well judged full loop, finishing very low. In contrast, for event 3, S/L. Bretherton, D.F.C., of No. 50 Squadron, demonstrated the Lincoln's ability to fly past on two engines, and finally on the port inner only, the three others being feathered. A request that S/L. Bretherton should try a third fly past using only his windscreen wipers was reluctantly refused.

F/O. Carter, of No. 247 Squadron, was next seen and heard approaching on his Vampire. He managed to look faster than the Meteor III and executed some good rapid rolls. His high-speed fly-past at very low level was definitely exciting.

Quite a different type of event followed when three Transport Command Dakotas, the leader carrying S/L. Smith, of No. 1 Parachute Training School, dropped fifteen fully equipped paratroops simultaneously. The descent made a fine spectacle and a freshening breeze made their well-judged touch-down in the middle of the field an amusing acrobatic performance.

Three Halifaxes then each dropped thirteen supply containers accurately in the airfield, orange, green, blue and khaki parachutes differentiating between the types of store. A Dakota also dropped panniers. More impressive perhaps than even the dropping of the paratroops was the release at 6,000ft by a single Halifax of a six-pounder gun, its four ammunition containers, a jeep and the Army gun crew of six, in that order. All landed safely within a small area.

Another item in a well-balanced programme was the excellent demonstration of a helicopter by S/L. Cable, of the Airborne Forces Experimental Establishment.

As a finale, Lt. Col. Retief, A.F.C., of the South African Air Force, flying from the E.F.S., gave a high-speed demonstration on a Meteor IV. On his first fly past he announced by R/T to control that his indicated speed was 595 m.p.h. or over 600 m.p.h. T.A.S. Experiencing difficulty with visibility he nevertheless turned round in a minute or so (covering some 20 miles) and flashed past again. There was no doubt that everyone was particularly thrilled by the speed of the Meteor, emphasized by the suggestion of vapour trials around the tail and by the way the sound followed the aircraft. Before departing Colonel Retief demonstrated the Meteor's speed of roll.

It seems a pity that more of the air-minded public could not have been present at this brief but very good demonstration. The many distinguished foreign visitors could not fail to have been impressed by the events.

Round the World

Successful Completion of 20,000-mile Flight in the Douglas Invader, "Reynolds Bombshell"

FLYING his converted Douglas A-26 Invader *Reynolds Bombshell*, Mr. Milton Reynolds, the American pen manufacturer, has completed a flight round the world in 78 hr 55 min. This time is 12 hr 19 min better than the previous one of 91 hr 14 min set up in 1938 by Howard Hughes flying a Lockheed 14.

There is no true comparison, however, between these two flights as the routes were different and Milton Reynolds was compelled to fly some 5,000 miles farther to avoid Soviet territory, having previously been refused permission to land. Neither flight conformed with F.A.I. requirements, and, in fact, no official round-the-world record has ever been set up. Reynolds flew approximately 20,000 miles, and the distance round the Equator is almost 25,000 miles.

Times and route are given in the accompanying table. For comparison Hughes' route was: New York—Paris—Moscow—Omsk—Yakatsk—Fairbanks—Minneapolis. Only two changes of plan were made by Reynolds and crew after their take-off on Saturday night, April 12th; Gander was used in place of Goose Bay, and Adak instead of Anchorage in the Aleutians, both as a result of weather troubles.

Stripped of its military equipment and armour the three-seat attack bomber should be rather faster than in military form, when the top speed was 345 m.p.h. at 5,000ft, and its weight, fully loaded, would now be about 30,000lb. The engines are Pratt and Whitney R-2800-71S, each of 2,000 h.p., and the fuel capacity is over 2,000 gallons.

Mr. Reynolds flew as navigator and his pilot was William O'Dom. An engineer, T. C. Salle, was also carried. For various reasons—the fifty-minute turn back to Adak due to severe headwinds, inability to overfly Calcutta, and cumulative delays at airports—the original idea of completing the flight in 55 hr had to be modified to 75 hr, which agrees quite well with the actual timetable.

Over certain parts of the route average speeds of 350 m.p.h. were achieved, and the overall average for the 20,000 miles, for which the flying time was 64 hr 37 min, works out at about 310 m.p.h. Several of the point-to-point flights on the route will constitute unofficial records, and a time of only 7 hr 4 min from Newfoundland to Paris is particularly striking. This whole successful flight, whatever its motive, reflects great credit on the crew of "The Bombshell" and on the makers of the airframe and engines. (*Photograph on page* 365.)

Route and Times, G.M.T.

Airport	Departed	Arrived	Time taken
La Guardia—Gander ...	Sat. 10.11 p.m.	Sun. 2.11 a.m.	4 hr 0 min
Gander—Orly	Sun. 2.51 a.m.	Sun. 9.55 a.m.	7 hr 4 min
Orly—Cairo	Sun. 10.35 a.m.	Sun. 5.52 p.m.	7 hr 17 min
Cairo—Karachi... ...	Sun. 8.12 p.m.	Mon. 3.2 a.m.	6 hr 50 min
Karachi—Calcutta ...	Mon. 3.56 a.m.	Mon. 8.5 a.m.	4 hr 9 min
Calcutta—Shanghai ...	Mon. 10.3 a.m.	Mon. 5.0 p.m.	6 hr 57 min
Shanghai—Tokyo ...	Mon. 6.13 p.m.	Mon. 10.00 p.m.	3 hr 47 min
Tokyo—Adak	Tues. 00.25 a.m.	Tues. 9.25 a.m.	9 hr 0 min
Adak—Edmonton ...	Tues. 00.24 p.m.	Tues. 8.55 p.m.	8 hr 31 min
Edmonton—La Guardia	Tues. 10.04 p.m.	Wed. 5.6 a.m.	7 hr 2 min

Distance—approx. 20,000 miles; Elapsed time—78 hr 55 min; Flying time— 64 hr 37 min; Av. speed—approx. 310 m.p.h.

To Geneva by Viking

Impressions on the First B.E.A. Viking Flight to Switzerland

THIRTY minutes is quite a lot of time to make up in a short journey of 475 miles in an aircraft with a scheduled cruising speed of about 170 knots. However, the reserve of power on the Viking enabled us to pick up that amount on a flight to Geneva last Friday. We were scheduled to take off from Northolt at 08.04hr G.M.T. and arrive at Geneva at 10.51 G.M.T. For some reason we did not actually get into the air until 08.35 at Northolt, and we rather naturally expected to be late at the other end. However, Capt. L. G. James opened up from the normal 1,600 revs and 33in of boost to 1,980 revs and 35in, which brought us over Geneva airfield several minutes ahead of the scheduled time. This was indeed an impressive performance, and suggests that, within reasonable limits, British European Airways' Viking schedules should always be punctual on arrival. There was, perhaps, a slightly noticeable increase in the normal engine noise in the forward seating positions, but at the rear of the aircraft everything was quite normal.

The first Viking proving flight to Switzerland was made on April 14th and 15th, but what might be described as a goodwill flight was made at the end of last week to enable some of the English Press, the Swiss Press, the travel agencies and some prominent personalities in Switzerland to see the Viking, hear about the new British service, and fly in the type of aircraft which will open the route, and also to permit B.E.A. to make final arrangements for the service.

Ventnor, the aircraft in which we flew, is a Mark 1B, but those who have travelled in B.E.A. Vikings will notice little difference except in the number of seats in the front compartment. The standard 1B, of course, carries twenty-four passengers. Passenger service during the flight was not in any way different from that which will be given on normal schedules, and there is no doubt that the Corporation has gone to great pains to make its passengers comfortable and contented during flight. Cold luncheon was served on a new type of moulded tray, which has been specially designed for B.E.A. Each article has a special compartment to prevent it sliding on to the floor. Attention from the steward to all the normal wants of passengers also created an excellent impression.

As for the Viking performance, the first delight was the good acceleration during take-off. The consequent short run and feeling of urge created confidence. Three flights were made at Geneva, and all the passengers were most enthusiastic about the aircraft's performance and the B.E.A. service. The Swiss particularly welcomed a British service with a British aircraft, and mentioned, especially after the flights, the comfort in the aircraft, the comparative noiselessness in flight and the easy manœuvrability. It was gratifying also to hear them comment on the extreme courtesy of the crew.

The return flight on Saturday was made in slightly less favourable weather, but it served to illustrate the stability of the aircraft in bumpy conditions, and once again we arrived over the airfield slightly ahead of schedule. The Corporation does not intend in any way to make a point of landing ahead of schedule, but it is intended to use the reserve of power in the Vikings, when take-off has been delayed, to make up time and arrive at the destination punctually. The direct route to Geneva, which in the Vikings will take about 2½ hours, is across some interesting country, and the time passes quickly.

The airport at Geneva has one runway only, with flat approaches at both ends. The wind direction is sufficiently constant, however, to make any additions quite unnecessary. Temporary wooden buildings are being used at present, but permanent ones and a wide apron are under construction. There is no real club activity there, but judging by the number of small aircraft seen flying and parked at the airfield, of which the greater number were Piper Cubs, there are many enthusiastic private owners.

R. P.

B.S.A.A. ACCIDENT IN WEST AFRICA

THE report on the accident to the B.S.A.A. York G-AHEW which occurred on September 7th at Yundum airfield, Gambia, had been issued. The aircraft left London Airport on the morning of September 6th and flew via Lisbon to Yundum, where it arrived at 02.43 hr on the 7th. A new crew took over. At approximately 04.08 hr the York started to take off and was watched from the flying-control tower until it disappeared from view. It has been estimated from eye-witness accounts that the take-off run was approximately 1,500 yd, but in the opinion of one, the aircraft was climbing steeply in comparison with other take-offs he had observed; however, nothing unusual was noticed in the noise of the engines. Shortly afterwards a loud noise was heard and a glow seen in the sky. The weather, which is considered to have had no bearing on the accident, was fair, with visibility 10 miles and cloud base 1,500ft 3/10 strato-cumulus. The wind was W.S.W. at two knots.

The aircraft had crashed in the bush nearly two miles south of the airfield. The port wing first struck trees 40-50ft high and then crashed through more trees as it rolled over to port. The engines were torn out and were found lying in the opposite direction relative to their positions in the aircraft, that is to say, the port engines were to starboard in the wreckage trail and the starboard engines to port. All the petrol tanks had burst, and a fire of considerable intensity had occurred in the last 100 yd of the wreckage trail. There was, however, no evidence of fire within the first 200 yd of the aircraft's passage through the bush. As far as could be ascertained there was no evidence to suggest that a failure had occurred or that any parts had become detached before the first impact.

During the life of the aircraft no major repairs had been necessary. The loaded weight at take-off, as calculated from the load sheet, was 68,770 lb. This was below the maximum permissible weight, 71,000 lb, and normally B.S.A.A. operate this type of aircraft up to 69,000 lb. The c.g. position of 29.6ft aft of the nose datum was also within the limits.

Capt. J. N. S. Cumming held a "B" licence, and a first-class navigator's licence. Before joining B.S.A.A. he had flown 2,760 hr in the R.A.F., mainly on twin-engined aircraft, including 400 hr night flying. Since joining B.S.A.A. he had flown 236 hr 21 min by day and 74 hr 27 min by night as first officer in Lancastrian and Lancaster aircraft. As captain he had flown 23 hr 3 min by day and 1 hr 55 min by night in these types, most of which had been on scheduled services. His flying experience in Yorks was 13 hr 37 min by day and 7 hr 13 min by night as first officer, all of which was on scheduled services. His time as captain in Yorks was 3 hr 52 min by day and 1 hr 3 min by night, none of which had been on a scheduled service. The flight during which the accident occurred was his first York command on a scheduled service, and it was also the first take-off he had made by day or night in the York loaded to more than 69,000 lb. Capt. Cumming had flown from the U.K. to Yundum as captain in a Lancastrian, landing two days before the accident.

The second pilot, First Officer M. G. Wade, held a "B" licence which was valid for D.H.82 and Proctor aircraft only. His time in Yorks was 36 hr 10 min by day and 4 hr 48 min by night, and nearly all his flying with the company had been carried out on scheduled services.

The report draws attention to the fact that the licences of the members of the crew were valid, but in view of the nature of the flight, and as the captain was himself the navigator, the first officer's "B" licence should have been endorsed for the York as required by A.N.D. 13 Section 11, Paragraphs 80 and 81. This, of course, had no bearing on the cause of the accident. In the opinion of the Chief Inspector of Accidents the accident occurred as a result of the captain losing control of the aircraft very shortly after it had left the ground. The cause of the loss of control cannot be determined with certainty, but that it was due to a mishandling of the controls by the captain is the most likely explanation.

Thornton Engine Laboratory

Research on Rich and Weak Mixture Performance, Direct Injection, Fuel Boiling and Turbine Lubrication

The imposing entrance of the engine research laboratory at Thornton, the motif of which was: "Second to None."

IN the early years of the war construction work began on an aircraft engine research laboratory at Thornton-le-Moors, Cheshire. By the middle of 1943 it was apparent that the accommodation available was no longer adequate, and so additions were put in hand. These were completed in July, 1945, the final installations of engines and equipment being recently accomplished. In the spring of 1942 the services of the laboratory were offered to M.A.P. for the duration of the war; this offer was accepted, and Thornton became the M.A.P. Fuel and Oil Research and Development Laboratory.

The establishment has now returned to the control of Shell-Mex, Ltd., and is directing its energies to civil aviation problems. The general idea behind the design of the building and its equipment was to produce a laboratory second to none of its kind. To-day some 300 staff are employed with about sixty scientists under the Director of Research, Brigadier R. A. Bagnold, O.B.E., F.R.S. The Aero Engine Laboratory is directed by Dr. C. G. Williams, the engineer in charge is J. G. Dawson, chief chemist Dr. T. P. Hughes and Technical Editor Dr. C. B. Davies. The facilities available in this magnificently equipped laboratory which we were invited to inspect include:

Nine full-scale single-cylinder test cells; five test rooms capable of housing up to twelve small-scale engines; cold rooms to accommodate a main engine and reach −40 deg C; two rig rooms; two main engines installed in a Halifax aircraft; analytical laboratory; fuel laboratory; oil laboratory; photographic department; electronics department; metallurgical laboratory with heat treatment room; instrument shop; microscope and balance room; machine shop; general fitting shop; engine fitting shop; electricians' shop; tinsmiths' and welding shop; fuel blending facilities; fuel stores; engine and materials stores; conference room and library; drawing office; report duplicating section; general administration offices.

Resistance to Detonation

The wartime research programme was necessarily determined to a large extent by war needs primarily related to improving aircraft power and range, altitude performance, and reliability.

The main factor limiting the power output from a given engine on a given fuel is detonation, and the problem of the detonation resistance of a given fuel in a given engine has to be considered under two main heads, (i) rich-mixture or take-off performance, and (ii) weak-mixture or cruising performance. During the early years of the war most emphasis was placed on rich-mixture performance, since the greatest need was for ever higher maximum speeds from fighters. There was abundant evidence that the octane number was not a reliable indication of rich-mixture performance, and the first problem studied at Thornton was the development of an improved test which would indicate most correctly the rich-mixture qualities of a fuel in order that adequate control might be maintained over this characteristic.

Late in 1943 it was indicated that, if a fuel could be made available having a rich-mixture performance 20 per cent better than that of the obtaining grade, certain engines could be up-graded to take advantage of the improved quality. Most of the initial experimental production blends were made up and tested at Thornton, and in the summer of 1944 the so-called "150 grade" was brought into use during the invasion of the Continent and was also used to give the extra speed required for countering flying bombs.

As the war progressed and it was realized that rich-mixture performance could be fairly readily obtained and controlled, greater attention was given to the weak-mixture performance because of its greater importance in relation to cruising range and load.

A programme of study was also undertaken in relation to direct fuel injection in German engines. The investigation showed that certain German engines required the use of a fuel superior to the current B 4, but it was evident that the highly aromatic C 3 fuel provided a very large margin of power which, incidentally, the Germans would not be in a position to use unless they improved their piston design.

A great deal of interesting information was also obtained regarding the characteristics of fuel injection used on German engines. This indicated that one of the important advantages of direct injection was the superior weak-mixture anti-knock performance. This would imply that, to obtain the given cruising output, a fuel of lower anti-knock value could be used with direct injection than with a carburettor. It was established that the reasons for this fact were the cooling effect due to the evaporation obtained by the injection of fuel direct into the combustion chamber, and the fact that direct injection permitted an increased valve overlap which, in turn, resulted in improved scavenging and internal cooling. Further development of this work is now proceeding at Thornton, and the work on direct injection has included a study of low-volatility so-called "safety fuels" and some of the problems involved in their use.

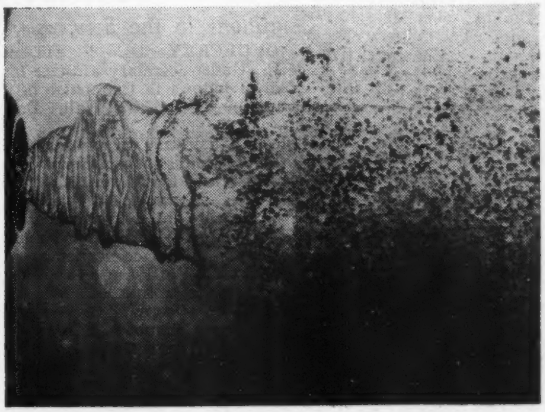
At the beginning of the war, altitudes of 20,000ft were considered high, whilst at the end of the war heights of 40,000ft were commonly reached. This necessitated constant attention to problems of vapour lock or fuel boiling. A great deal of fundamental work on this subject has been done at Thornton and, in one case, information supplied to the manufacturers enabled an increase in ceiling of about 10,000ft to be achieved. One of the factors which

THORNTON ENGINE LABORATORY

was often difficult to evaluate in rig tests was the degree of evolution of air from the fuel during a rapid climb. Apparatus was, therefore, designed for taking sealed samples of fuel during climb on a Merlin-Spitfire, the results showing that, in general, the air tends to remain in super-saturated solution in the fuel until the boiling altitude is reached, at which point there is a rapid evolution of air which tends to aggravate the effects of fuel boiling.

General service experience combined with the results of the laboratory investigations have clearly shown that engine reliability is to a large extent determined by the formation of deleterious deposits from the fuel and lubricant. The programme at Thornton on engine deposits has, therefore, been devoted to the following studies: (a) factors controlling oxidation of lubricants and the development of engine and laboratory test methods, and (b) the conditions under which deposits of lead compounds occur. In these investigations, fundamental studies on oil oxidation, ring sticking, sludge, deposits of lead compound, exhaust valves, piston ring, cylinder liner and gear wear were all undertaken.

The problem of starting engines from cold at very low temperatures became of considerable importance during the war, and experiments at Thornton established that, by dilution (on the Worth system) with subsequent cranking and priming, it was possible substantially to reduce the



A gas turbine fuel spray photographed at an exposure of one two-millionth part of a second. The spray is bad in this case, the pressure of 15 lb per sq. in being unusually low.

cranking effort at low temperatures and without excessive dilution of the engine oil. Subsequently experiments carried out on a Merlin 38 at temperatures down to −40 deg C showed that the criterion for adequate oil dilution was satisfactory oil flow after starting, cranking speed being of secondary importance. A main work is the development of improved oils to give greater life by chemical additives and this work has already had important effects.

In the photographic section where colour is largely used to show true discoloration caused by heat, a special camera has been devised to show a complete piston "rolled out" on one negative. While the camera lens sweeps from right to left, the piston is rotated 360 deg in unison in the opposite direction to give a "flat" all-over picture. There is also a cathode-ray oscilloscope for engine research on which the scale may be greatly magnified to study engine phenomena.

In the early days of the gas turbine a valuable factor in making it a practical proposition was the introduction of the "Shell" combustion chamber employing the direct injection of fuel into the combustion zone. The majority of existing combustion chambers resulted from the development by engine manufacturers of this basic conception. During the war years the emphasis of development was on the quick production of a gas turbine suitable for flight use in jet-propelled aircraft, and many avenues of research had to be left unexplored. It was evident, however, that problems would arise which would necessitate investigation of the effect of fuel characteristics and of combustion on the process, and late in 1944 a programme of research was arranged and special plant and equipment obtained for the operation of full-scale combustion chambers.

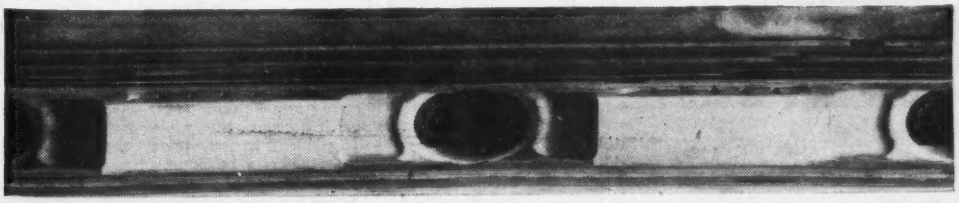
This research work applied particularly to fuel characteristics, combustion efficiency from temperature measurements, gas analysis and carbon deposition. Formation of carbon in combustion chambers is an indication that combustion conditions are imperfect. Carbon formations may cause local overheating and buckling of flame tubes, erosion of the turbine blades or blockage of the turbine nozzles by carbon lumps which break loose from the flame tube. At Thornton full-scale tests are carried out under conditions which aggravate carbon deposition, such as by employing an air-fuel ratio of 50: 1 for a duration test of one hour.

Testing Flame Tube Temperatures

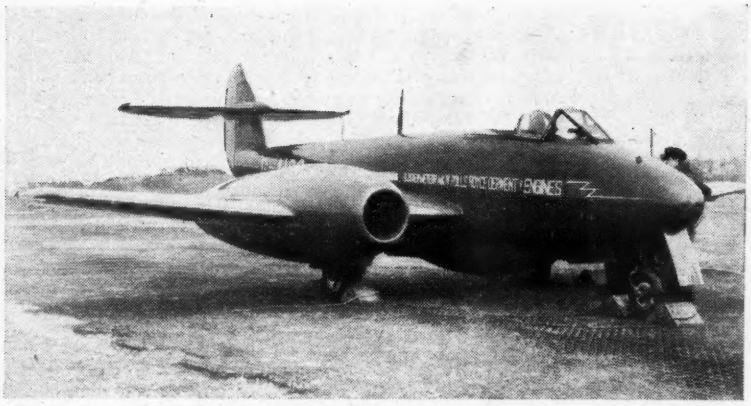
To test flame tube temperatures, sixteen thermocouples are fitted in the wall of the flame tubes and a comparison made of the temperatures attained under identical conditions of operation on different fuels, some with aromatic content. Buckling and cracking of flame tubes is attributable, in the main, to the combined effects of overheating, resulting from localized over-rich mixtures, and of unsymmetrical air flow around the outside of the flame tube resulting in undercooling of the same areas.

At the present time, studies are being carried out on miniature quartz combustion tubes with the object of studying fundamental aspects of problems such as carbon formation, combustion efficiency, blow-out limits, flame length, flame vibration and flame colour. One set of combustion tubes is devoted to studies carried out using gas butane as fuel, thereby eliminating the atomization process; another tube is operated on a pre-vaporized petroleum fraction; and, finally, a tube is being developed to use a small atomizer so that liquid fuels can be tested. In addition, important methods of gas analysis have been developed which enable the combustion efficiency to be determined more correctly and expeditiously

Because of the high speed of rotation and the low temperature requirements of the bearings, gas turbines require a lubricating oil of low viscosity. For satisfactory lubrication of the reduction gears in an airscrew-turbine the load-carrying capacity of such an oil must be at least as great as that of the normal reciprocating engine lubricant. These requirements cannot be met adequately by a hydrocarbon lubricant oil, but the required performance can be obtained by the use of additives in a high viscosity index light petroleum oil.



A "rolled-out" picture of a piston by a special form of traversing-lens camera used by the Thornton Research Centre.



STAR PERFORMER: The Gloster Meteor IV, which Eric Greenwood and S/L Cotes-Preedy are taking to the Continent for a demonstration tour, on the tarmac at Manston. It is the first jet aircraft to have civil registration letters.

Welcome Visitors

FROM Washington comes the news that nine Superfortresses on a training mission will fly to Germany at the beginning of June and afterwards visit ten R.A.F. bases in England before returning. A total of about 150 U.S.A.A.F. officers and men will participate in the flight.

Urgent Journey

COL. SASOUSCHUK, assistant air attaché to the Russian embassy in London, recently left Northolt for Moscow in a Russian Dakota to undergo an operation on an old war wound. He was a bomber pilot and was wounded in the thigh.

Berlin Birthday Party

AN International cocktail party was given by Air Marshal A. P. Davidson, C.B.E., Chief of Combined Services Division, in Berlin on April 1st—the 29th anniversary of the birth of the R.A.F.

Amongst the two hundred guests entertained at the Air Marshal's private residence at Douglas Strasse in the Grunewald were representatives of all the Allied Nations. Some who attended were: General Brownjohn (Deputy Military Governor of Berlin), General Nares, Lady Robertson, Mrs. Clay (Wife of the American Deputy Military Governor), General Harper and General and Madame Friis of the Danish Military Mission.

Sinking in the Ooze

A RECENT report on the condition of La Guardia airport, much of which is built on reclaimed land, states that the ground has already settled by about 5 ft and will continue to do so for another 5 ft at the rate of about 6 inches a year. Certain portions of the runway may soon be flooded by high tides.

ROTATING PARACHUTE: Vittorio Isaaco demonstrating his telescopic rotor which, it is claimed, can be used as a parachute for individuals and cabins, supply and mail dropping and as an auxiliary device for taking-off or landing highly loaded aircraft.

HERE &

Long-range Comfort

AN American ex-Service pilot has designed a new aircraft seat incorporating a lumbar pad to prevent discomfort to pilots on long duration flights. Try-out equipment is fitted to the special Hawaii-New York P-82. The cushions are multi-cellular and have rubber bladders between layers of foam rubber. A small pneumatic motor weighing 11 oz causes increases and decreases of pressure in alternate cells, thus "massaging" those parts of the body most susceptible to fatigue. Aeromat Products Company of Buffalo are the manufacturers.

Air-sea Safety

THE American magazine "The Search and Rescue Bulletin" has now changed its title into "Air-Sea Safety." It is published in Washington, but the representative for the British Empire and Europe is G/C. G. E. G. Lywood, whose office is at Adelaide House, London, E.C.4. As its title implies, the new journal will be devoted to discussions on all safety measures at sea and in the air.

Conditions in the Services

MR. GEOFFREY DE FREITAS, M.P., Under-Secretary of State for Air, spoke as follows in the course of a speech at the Old Shire Hall, Dorchester:—

"There is a tendency to assume that conscription would be unnecessary if conditions in the armed forces were made far more attractive. I am not prepared to argue whether or not sufficient forces could be raised in this way, but I must give a warning of the consequences of raising the standard of living in the Services too high above that of civilians. We should merely be copying the German method of making members of the Services a race apart from the community and a race with additional perquisites and perogatives. This Government, like any democratic Government we may have in this country, will never set the stage for military rule. But this Government is equally determined that the men and women in the Services shall have a fair share of the wealth of the country and that they will not be treated as they were before the war as the poor relations of the community."

Price of Speed

ACCORDING to a paper delivered at the annual meeting of the Institute of the Aeronautical Sciences by Mr. A. C. Charters, of the U.S. Army Service Forces, Ordnance Department, a fuselage designed for supersonic speed and having a maximum diameter of 50in would require 2,263 h.p. at a Mach Number of 1.5 at a height of 50,000ft. The shape is straight-lined, with conical head and tail and a cylindrical middle portion. The best nose-cone angle (semi-vertex) is in the neighbourhood of 4 deg and the tail-cone angle does not appear to be critical. At the same Mach Number (1.5), but at sea level, the power required would be 21,243 h.p.!

An interesting thing is that computations for a 20 mm model at a Mach

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Number of 5 at sea level show good agreement, so that the practical designer should be able to use small-scale model tests at sea level satisfactory for predicting the performance of the full-scale machine at altitude.

To Sweden in 2 Hours

HISTORY was made on April 17th, when John Cunningham flew a de Havilland Vampire non-stop from England to Sweden. The route followed was via Den Helder, Sylt and Gothenburg to Norrköping. The distance flown was 850 miles and the time taken 1hr 58min, an average speed of 425 m.p.h.

Mr. Woodburn at Derby—

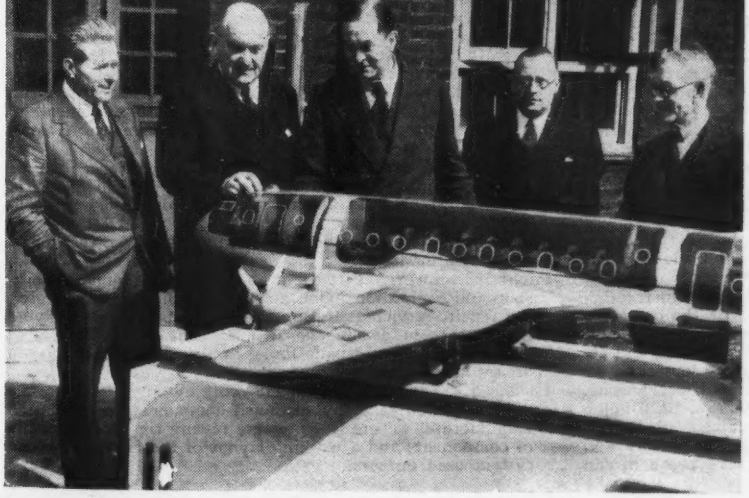
MR. ARTHUR WOODBURN, Joint Parliamentary Secretary to the Ministry of Supply, lately visited the Rolls-Royce Research and Development Establishment at Derby. He was accompanied on his tour of inspection by Mr. E. W. Hives, managing director, and expressed pleasure at seeing first-hand the tremendous drive Rolls-Royce are putting into jet research and development —such an important factor in maintaining Britain's lead in jet propulsion. Some of the units he saw were for export to Russia.

—and at Cricklewood

ON April 18th Mr. Woodburn made a tour of the Handley Page works at Cricklewood, where he inspected the production of the Hastings and Hermes. Mr. Woodburn made the first official announcement of the fact that the Ministry of Supply has ordered 25 Hermes IV civil transports for use by B.O.A.C. on the Empire air routes. Deliveries will begin next year, and from the beginning of 1949 the rest are expected to be handed over at the rate of four a month.

GLOBAL INVADER: The modified Douglas A.26, *Reynolds Bombshell*, which recently completed a round-the-world flight in record time (report on p. 360). Congratulated by President Truman at the White House, Mr. Milton Reynolds said, "Whoever says it's a small world has not been round it recently."

INFORMED INTEREST: Mr. J. R. D. Tata and Mr. B. W. Figgins, the general manager of Air India, inspecting the Airspeed Ambassador at Christchurch.



FOR EMPIRE ROUTES: Inspecting a model of the Hermes are Mr. Manson, Director of Aircraft Production, Sir Frederick Handley Page, Mr. Woodburn, Major Nicholl and Mr. Hamilton.

Some Climb!

AN official American statement claims that the little Bell XS-1, which is dropped from a B-29, climbs at a rate of 120,000ft per minute. It weighs 13,000 lb at take-off but only 4,900 lb on landing, due to the fact that it consumes 190 lb of fuel per second at full power. Climbing from 15,000ft it has reached almost 80 per cent of the speed of sound.

News in Brief

ELECTRONIC TRANSMISSION EQUIPMENT, LTD., is the title of a new company formed by the Mullard Wireless Service Co., Ltd. It will take over the present communications activities of Radio Transmission Equipment, Ltd.

* * *

A branch of Airwork's repair and maintenance organization is about to be opened at the Homewood site at Langley. This unit will be under Mr. J. G. Langford. General service manager in charge of all Airwork repair and maintenance branches is Mr. R. W. Cantello.

* * *

An exhibition to celebrate the fiftieth anniversary of the formation of the Marconi Company is being held in Queen's House, Kingsway, and will remain open until May 2nd. The exhibition was opened on April 22nd by Sir George H. Nelson, chairman of the Marconi companies.

WHEELED INSTRUCTION

Tour of R.A.F. Mobile Classrooms

ONE of the first mobile classrooms made available to the R.A.F. was a civilian motor coach converted and equipped by the de Havilland Company in 1941 to offer instruction on D.H. airscrews. Due to the shortage at that time of labour, materials, tyres and petrol the number of vehicles manufactured specially as classrooms did not exceed ten until mid-1945, but there are now 43, available for service anywhere in the world.

Some preliminary notes on the classrooms were published last week, and on this page are set out details of individual vehicles, twenty of which, in four convoys, left the Horse Guards Parade on April 16th to visit many towns throughout the country. Each convoy, or team, is led by a recruiting van and will be on show for lengthy periods in forty-four towns, apart from short stops *en route*.

The various manufacturers have given great assistance to Technical Training Command in the preparation of the vehicles and in many cases have supplied their own instructors.

TEAM "A."

Boulton Paul Type "D." Fitted out for instruction to air-gunners, armourers and electricians on the operation and servicing of the Boulton Paul Type D front turret as fitted to the Lincoln. A workable turret is installed in the classroom and there are four synchrophones to show the operation of different mechanisms.

Rotol No. 5. Instruction is given in this classroom in the operation, servicing and rectification of faults of Rotol electric airscrews. A cinematograph projector is carried.

Sperry No. 1. An instructional workshop and calibration shop. It is possible in this classroom to repair any Sperry gyro instrument or the type A.3 automatic pilot as supplied to the R.A.F. It contains its own compressed air and suction supply as well as lathes, drilling machines, etc. A 16-mm cinematograph projector is fitted.

Dowty No. 1. The instructional equipment in this consists of a complete Dowty hydraulic system as fitted to fighter aircraft. There are sectioned components and a 16-mm cinematograph projector, as well as a synchrophone.

Automatic Pilot No. 1. Fitted with a working layout of the Mark VIII automatic pilot as was used on most R.A.F. heavy bombers during the last stages of the war. Equipment is carried so that repairs can be made.

M.T. Tyres No. 1. The servicing, repair and storage of mechanical transport tyres is taught in this classroom. There are many interesting sections of outer covers showing the various types of damage that may be caused by bad driving or faulty maintenance. Films showing M.T. tyre repair and servicing can be presented with the sound cinematograph projector.

TEAM "B."

Claudel Hobson Carburettors. Designed to give instruction on the servicing and repair of all aircraft carburettors and injectors of Claudel Hobson manufacture used in the R.A.F. It contains sectioned units and components.

De Havilland Propellers No. 2. Fitted out so that instruction can be given on all types of de Havilland variable-pitch airscrews. Besides normal instructional equipment there are several sectioned airscrews and components and a cinematograph projector which shows films on the functioning and servicing of airscrews.

Dowty No. 2. In this classroom is a complete Dowty hydraulic system as fitted to a bomber. There are sectioned components and a 16-mm cinematograph projector.

Boulton Paul Type "F." This is fitted out to give instruction to air gunners, armourers and electricians on the operation and servicing of the Boulton Paul Type "F" rear turret. There is a workable turret installed in the classroom and besides normal instructional equipment there are four synchrophones which explain the operation of different mechanisms.

Dunlop Pneumatics. Equipped for instruction on the Dunlop pneumatic system as fitted to a large number of R.A.F. and civil aircraft. It contains sectioned components and has gear with which any normal pneumatic component can be tested. Its synchrophone gives instruction on the Dunlop pneumatic brake relay unit.

Bostick Products. Designed to give instruction on the correct application of all Bostick products used in the R.A.F. It contains samples of the different materials that may be joined with the various Bostick compounds.

TEAM "C."

Derwent Gas Turbine Engines. This is planned for instruction on the Rolls-Royce Derwent gas turbine engines as used by the Gloster Meteor. Fitted in this vehicle is a sectioned Derwent engine and many sectioned components. A 16-mm sound cinematograph projector is carried and descriptive films of the gas turbine engine can be shown.

F.N. 82 Turrets. Fitted out to give instruction to air gunners, armourers and electricians on the operation and servicing of Frazer Nash Type F.N. 82 rear turret which is fitted to Halifax aircraft. A workable F.N. 82 turret is fitted inside the classroom and there is a synchrophone for explaining various mechanisms.

Rotol No. 4. Instruction can be given in this classroom in the operation, servicing and rectification of faults on Rotol hydraulic airscrews. A cinematograph projector is fitted.

S.U. and Stromberg Carburettors. To be used for instruction on the Stromberg and S.U. carburettors and injectors used in the R.A.F. It contains sectioned components, working diagrams, and a cinematograph projector.

Flight Instruments. This is equipped as a mobile instrument workshop and calibration room and instruction can be given on the repair, servicing, testing and calibration of most flying instruments in use in the R.A.F. The normal machines and test apparatus usually found in an instrument workshop are set up here.

Lockheed. Containing a complete working aircraft hydraulic system fitted as well as many sectioned components of Lockheed manufacture. There is a pressure testing rig for the testing of components and a working layout of the Lockheed brake system used on cars.

TEAM "D."

Goblin Gas Turbine Engines. This has a sectioned de Havilland Goblin gas turbine engine so that instruction on the maintenance and running faults of this engine can be given. It also contains a cinematograph projector for showing films on the functioning of the Goblin, which powers the Vampire fighter.

B.17 Turrets. Arranged for instruction to air gunners, armourers and electricians on the operation and servicing of the 20-mm cannon turret fitted to the Seaford flying-boat and Lincoln bomber. A workable turret is fitted in the classroom and there is a synchrophone explaining the operation of the different mechanisms.

Aircraft Tyres No. 2. Designed so that instruction may be given on the correct servicing and repair of all types of aircraft tyres. It contains equipment made by the Dunlop firm, including vulcanizing repair outfits which enable units in the field to carry out repairs which would otherwise mean the return of the tyre to a repair unit. A 16-mm cinematograph projector is fitted so that films on tyre maintenance may be shown.

Rotol No. 2. Instruction and practical experience can be given in this classroom on the repair of wooden blades of Rotol constant-speed airscrews. It is completely self-contained as regards benches, jigs, tools, etc., and there is a cinematograph projector for showing films on the repair of wooden blades.

Flight Instruments. Fitted out as a mobile instrument workshop and calibration room, and instruction can be given on the repair, servicing, testing and calibration of most flying instruments in use in the R.A.F. The normal machines and test apparatus usually found in an instrument workshop are set up in this classroom.

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American Newsletter

Ballyhoo Research : Buffeting and Twin Booms : Aircraft Nomenclature : Castering Undercarriages

By "KIBITZER"

IT is an unfortunate fact that the American love of the spectacular, combined with accompanying publicity, is apt to make other nations sceptical of the value of their achievements. The trans-continental and other long-range flights by U.S. army aircraft are cases in point. Nobody will deny that the U.S.A.A.F. and the American aircraft manufacturer derive much valuable publicity from such ventures, and very often and hidden away in all the surrounding ballyhoo which seems so strange to the European, there is a lesson to be learnt or a line of development that is valuable. The 5,651-mile, 14½-hour, non-stop flight of the North American twin Packard-Rolls P.82 from Hawaii to New York is a case in point. Although designed during the war this is the first publicity-making performance of this rather unorthodox type. More generally known as the "Double-Mustang" (because of the Siamese-twin-like joining together of two P.51s by a common centre section and tailplane), it was intended for the Pacific war where long range, and a good load of fuel, bombs, or packages were paramount requirements. On paper, however, it may have been a better specification than it was in actual practice. Although it had good range and could carry a versatile load, the handling characteristics were reported as poor, anyhow on the early models. The troubles encountered seem to have been identical with those found on most twin tail-boom aircraft, with buffeting and poor stalling qualities under high loadings, largely due to interference from the centre section. The end of the Pacific war probably prevented these troubles from being such an urgent problem as they were in the early days of the P.38, but their presence emphasizes the difficulties that seem to be inherent in making a fast twin tail-boom fighter behave properly at high G. and at high Mach numbers, unless the tailplane is set very high.

For this particular long-range flight 2,215 U.S. gallons of fuel were carried in the fuselage tanks behind the cockpits, and in four external wing tanks. Photographs of the machine taxying-in at La Guardia Field, New York, show two wing tanks on the starboard wing and one on the port, so presumably, at least two of these tanks were droppable but one failed to jettison. Neither armour nor guns were fitted, and even then the take-off weight was 30,000lb. This represents a wing loading in the region of 73.5lb per sq ft. The average speed was about 344 m.p.h. and the Air Corps were said to have been disappointed in this figure, so either the expected tail winds didn't materialize or the failure to jettison some of the wing tanks slowed things down a bit. As a flight, however, and particularly when applied to long-range fighter escort requirements, it was a good one, and suggests that the operational range of this machine would be in the neighbourhood of 2,000 miles. For such a flight two pilots would be a necessity, and this, combined with the heavy fuel-load required, armament, radio navigational aids and such like, seems to lift these ultra-long-range escort machines out of the fighter class altogether. This raises the next question, how to protect the "World-wide" bombers? Maybe they, or their accompanying bombers, will carry their own defence fighters.

NEW TYPES IN THE AIR

TWO new types, both west-coast built, are now undergoing their first flight tests. These are the North American military medium bomber, the XB-45 (having got its jet engines at last), and the Consolidated Vultee civil airliner, the 240. Very few details of the former have been published, but a photograph shows it to be a well-streamlined, orthodox-looking bomber with four jet engines mounted in pairs in double-entry nacelles set well forward in each wing. The tailplane has considerable dihedral. No guns, gun turrets or ports are visible in the photograph. A crew of four is carried in the pressurized cabin. The wheels, in order to get them into the thin wing, have high-pressure, narrow-tread tyres, a feature which certainly presupposes that the machine will always operate from prepared runways!

This month's initial flight of the Convair 240, which is a development of their model 110 and which was first ordered by American Airlines and therefore presumably incorporates to a large extent that company's requirements, was somewhat of a surprise, as rumour said it was behindhand and unlikely to fly before May. It did a two-hour flight, and an air-to-air photograph shows a machine of standard design with well-cowled engines, a thinnish wing, and what appear to be exceptionally large wing-root fillets. The power plants are two Pratt and Whitney R.2800 engines, and the specification quotes an empty weight of 24,754 lb; and an all-up weight of 39,000 lb; a cruising speed of 300 m.p.h. at 16,000ft, and a range of up to 700 miles. There is seating for 40 passengers, in a pressurized cabin, making this the first pressurized twin-engine transport to be flown over here. (The next should be the Martin 333, but this latter is not ready yet.) The latest selling price of the 240 is given as $263,000. The fact that this machine is now flying should enable the manufacturers to make some deliveries by the end of the summer, and although at one time the Martin 202 seemed to be having things all its own way as regards orders, the 240 is coming into the home stretch with a rush, and will, in any case, give its rival a run for its money in popularity.

SAFETY TRENDS

A THIRD machine now flying which is of interest because of its unusual features, is the new high-wing, four-seater, Waco "Aristocraft." Incidentally, someone should do something about aircraft nomenclature. It is rapidly approaching those unutterable depths more usually associated with the names on the gates of seaside bungalows! But be that as it may, it is obvious that a much higher and more interesting level of thought has gone into the design than into the name. This is particularly so in regard to the safety requirements, thereby following a strongly marked "safety trend" which is becoming increasingly important in light aircraft design over here. As examples of this the control wheels are shaped to fit the chest, are made of steel tube that will bend, not fracture, and the control rod incorporates a friction bearing device which will act as a shock absorber if the occupants are thrown forward against the control wheels. Although the machine is a pusher with a shaft drive to the propeller in the tail (this is guarded on each side by the twin fins and rudders) the engine and battery are situated ahead of the occupants. The fuselage is of steel tube, designed to buckle in a crash in such a way as to avoid injuring the occupants, and seats and safety belts are also designed to minimize injuries. The nosewheel is either steerable or castering, and the undercarriage, when retracted, does not entirely disappear but will function even if a belly landing is made.

The result of all these innovations is a somewhat unconventional-looking aircraft which may not have as good a performance as it should. Fitted with a 215 h.p. air-cooled Franklin the published figures give a cruising speed

AMERICAN NEWSLETTER

of 135 m.p.h. at sea-level, 152 m.p.h. at 5,000 feet, and 165 m.p.h. at 10,000 feet. Percentage power required for these speeds is not quoted. The range is said to be 657 miles (why bother about the 7?) and the take-off run 708 feet at sea-level against a 10 m.p.h. wind. The price is 9,980 dollars. Following what is now known as "Ercoupe practice" (a phrase which always strikes me as being rather hard on the Hordern-Richmond twin which I flew, rudderless, in 1938 or so) a two-control system is fitted, giving suitable non-stall, non-spin characteristics, probably achieved by restricting the control movement. On the whole it is not a pretty machine to look at, but the fact that it does try to give the customer both comfort and safety, and that the firm's reputation is still worth something, may make it popular.

A NEW/OLD IDEA

TALKING of the Hordern-Richmond twin and its two-control system, brings to mind another pre-war British development which has suddenly been taken up here not only with gusto but also, apparently, with the bland assumption that it is just one more all-American invention. This is the castering undercarriage, which is now being pushed by the Goodyear Company as the answer to all cross-wind landing ills. Whether this particular undercarriage infringes any of the Maclaren patents (if there are such patents) one does not pretend to know, but just in case any of my American friends read these notes, I would like to say that we were doing cross-wind landings with a Maclaren castering undercarriage at Heston Airport, London, in 1939, and that I believe I am right in saying that considerable research work was done in England on this idea during the early days of the war. Whether it will be developed here as a standard fitment, or even as a "customer request" item, remains to be seen, but credit for its original development should be given to Maclaren. —Or am I wrong, and was there some long-forgotten pioneer who developed something of the sort away back in the very early days?

[*"Kibitzer" is right in suspecting that some pioneer was the first to adopt the castering undercarriage. The pioneer was Louis Bleriot, and castering wheels were fitted to the monoplane on which he made the first flight across the Channel in 1909. They were retained on all subsequent types until the design of Bleriot aircraft changed completely. The idea of the Maclaren undercarriage was, however, different in that it was designed to be pre-set to the landing angle of drift.*—ED.]

FREIGHT CARRIERS

AT the risk of being a bore on the subject of freight and freight-carrying aircraft, I would like to quote some more figures as proof of my conviction that air cargo is becoming a vitally important part of the aircraft industry. Estimated statistics show that in the United States during 1945 the eight largest non-certified carriers flew a total of 27,783,000 ton-miles, and the eight biggest airline companies 18,318,000 ton-miles. Although the uncertified, that is to say the non-scheduled operators, carried more than the certified regular airlines, it must be remembered that the former were first in this type of business, and in some cases it was not until well into 1946 that the airlines really got going. Moreover, the statistical forecasters (a race that should always be treated with caution) estimate a total value of 15,000,000 dollars gross for this business in 1947. Even if this figure is not realized there is no question that a huge potential industry is in the making, and this won't be confined to the United States alone.

The immediate question is what sort of aircraft is suitable for this work. We have the Wayfarer, the Fairchild Packet, and the Northrop Pioneer, all especially built to carry freight. Now a new company, composed of ex-Curtiss Wright employees, are converting Curtiss Commandos (C-46As) for cargo work. There are said to be some 600 machines of this type available from Army Air Corps disposal stocks, and this new company estimates that they can convert them to freighters at the rate of 10 per month, and sell them for around $70,000. The all-up weight of this machine is 45,000 lb, and it is quoted as having a maximum range of 1,500 miles with a 9,000 lb payload. Esimated flying costs vary between 8-9 cents for 1,000-mile trips, and 7.05 for short 200-mile hops, based on 100 per cent load factor. Cruising powers and speeds for these operations are not given. The conversion of military wartime aircraft cannot go on indefinitely, however, and it seems reasonable to suppose that in the future we may expect various types of specialized freighters to be built. Certainly the slow "tramp steamer" will have its place, and at the other end of the scale may be a high-speed, high-altitude machine which would carry both perishable goods and mail. Quite why no one has considered this latter type as yet is surprising, for surely such a machine, if only for mail, could now be justified? Maybe the postal authorities haven't supported the idea, but it does seem an inevitable development of the freight-carrying business, and if the mail was standardized and perhaps compressed it would surely stow in a comparatively small space and permit an interesting design of aircraft?

BRITISH LECTURES IN CZECHOSLOVAKIA

FOUR senior lecturers from the College of Aeronautics at Cranfield have just returned from a visit to Czechoslovakia, which they visited at the invitation of the Czechoslovak Ministry of Education. The subjects and lecturers were: Development of Gas Turbines (Dr. A. W. Morley), Current Problems in the Theory of Aircraft Structures (W. S. Hemp), Aerodynamics of High-speed Flight (A. D. Young), and Flight Testing at High Speed (A. Hampden Yates).

The party visited various departments of the university, the Czech "R.A.E." at Letany, the Avia factory, the Walter aircraft engine factory, and the gliding club at Rana. The British visitors were given a great welcome, symbol of the desire of the Czechs for closer relations with British aeronautics.

HYDROMATIC AIRSCREW DEVELOPMENTS

IT has been announced that Douglas D.C.6s for United and National Airlines, Sabena and others are to have specially developed three-bladed Hamilton hydromatic airscrews. In addition Canadian-built D.C.4M transports for the R.C.A.F. are also, it is stated, to be fitted with this D.C.6-type airscrew. Improvements include newly designed light-weight duralumin blades equipped with tuned vibration dampers in the hollow shank (other new models for the Martin 202 and 303, the Consolidated 240 and the Lockheed 649 Constellation have hollow steel blades); an improved pitch-changing mechanism using higher oil pressure but giving more accurate constant-speed operation; rapid reversing and feathering (three seconds); automatic synchronization of all airscrews with a master control in the cockpit and electric de-icing.

FORTHCOMING EVENTS

April 24th.—Royal Aeronautical Soc.: "The Risk of Fire, and Fire Prevention Methods," Dr. J. Drinkwater, B.Sc., D.Phil., and W. G. Glendening.
April 25th.—R.Ae.S. (Bristol): "Some Problems of High-speed Flight," S. C. Redshaw, F.R.Ae.S., 5.30 p.m.
April 29th.—R.Ae.S. (Derby): Conversazione, 6.30 p.m.
May 2nd.—R.Ae.S. (Graduates and Students): "Flight Testing of Aircraft," W. Humble.
May 3rd.—British Interplanetary Soc.: "Nature and Distribution of Meteors."
May 9th to 12th.—Royal Netherlands Aero Club. Aerial rally at Ypenburg, The Hague.
May 10th.—Air League of the British Empire (Portsmouth): Air Display at Portsmouth Airport.
May 18th.—Southern Area Model Flying Championship. A.S.T. airfield, Hamble, Hants, 2 p.m.—6 p.m.
May 29th.—Royal Aeronautical Soc.: Thirty-fifth Wilbur Wright Memorial Lecture "The Development of All-wing Aircraft." To be read by J. K. Northrop.
June 21st.—Air League of British Empire. Flying display with R.A.F. support. Baginton airfield, Coventry.
July 4th to 20th.—Brussels International Aero Show.
July 9th to 30th.—Air League of British Empire. Blackpool (Squires Gate) Meeting. Flying displays with R.A.F. support on 9th, 16th and 23rd.
Sept. 9th to 12th.—S.B.A.C. Exhibition and Display.

ROLLS-ROYCE EAGLE

New 24-cylinder Sleeve-valve Unit of 3,500 B.H.P.

WITH what may well prove to be the last of the very high-powered piston engines Rolls-Royce have resurrected one of their most famous type names—Eagle—and on examination there is no reason to believe that this latest Derby creation will not carry to new heights the lustre bequeathed by its famous namesake.

The new Eagle is a twin-crank flat-H sleeve-valve engine aspirated with a two-stage two-speed supercharger, and, in Mk 22 form, is equipped to drive an eight-blade contra-rotating airscrew. It is the first Rolls-Royce production sleeve-valve engine, although the company extensively investigated the potentials of sleeve valves as a part of their normal research programme in the early 1930s. In point of fact, although it is not generally known, Rolls produced an air-cooled 22-litre sleeve-valve 24-cylinder engine of X-form which, called the "Exe," first flew in September, 1938, in a Fairey Battle. This was a quite successful engine, but it was dropped in order that full effort could be concentrated on Merlin production in view of the gathering war clouds. In addition to being the first R-R sleeve engine, the Exe was also the first air-cooled engine produced by the company since the 1914-18 war.

Before going on to consider the Eagle in detail we might briefly run over the design factors that decided its form: the initial design project was conceived toward the end of 1942 as the necessity for a higher-powered engine was foreseen. Considerations of aspiration and flame travel set a more or less effective limit of about 6 inches to bore size, and with cylinders of this order it has been established that 12 pistons per crankshaft is about the practical limit. Thus a twin-crankshaft engine was necessary, and the disposition of the cylinders in a flat-H followed naturally, since far and away the best installation case is met by this layout.

Sleeve valves were decided upon in view of the fact that they undoubtedly offer advantages over poppet valves from the aspect of maintenance and obviation of adjustment; and whilst no one would be so reckless as to suggest that the poppet valve has reached the ultimate peak of development, it is not far short of the summit and its limitations are very well known.

These factors were the underlying fundamentals which led to the Eagle. As to its use, we are permitted at present to say no more than that it is to be the power unit of the Westland Wyvern T.F.1 naval aircraft, but for the future it is, perhaps, more than likely that the Eagle may serve to power more than one civil aircraft—particularly in view of the airscrew-turbine position.

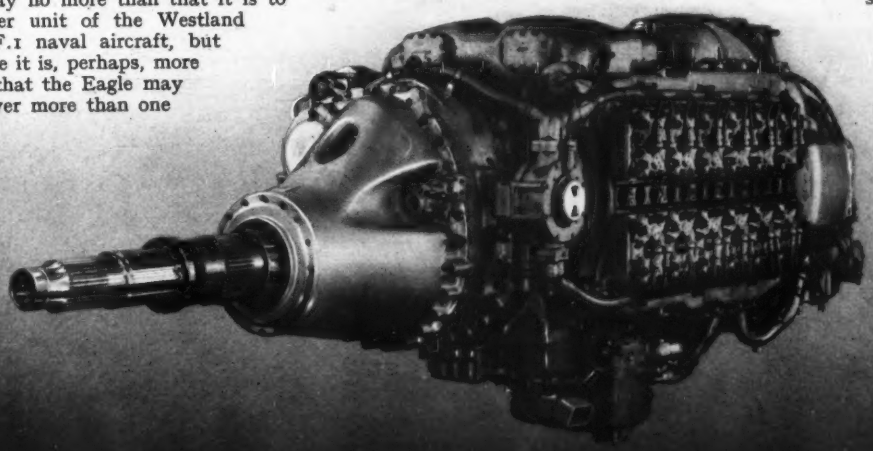
In general terms composition of the Eagle may be summarized as consisting of twelve cylinders on each side formed in monobloc castings, through-bolted with the vertically split crankcase. Each row of six cylinders is served by its own induction manifold which, in turn, is fed from an individual aftercooler. Exhaust is through paired ejector stacks mounted in a central row between the upper and lower banks of cylinders. The reduction gearing is powered equally by both crankshafts, and with it is incorporated the contra-rotation gear for airscrew drive. In this particular instance—i.e., the Mk 22—the nose-length requirements of the aircraft in which the engine is first to be installed have called for an extended snout housing forward of the reduction gear, but for other installations this might not apply, and the overall length of the engine would thus be reduced by perhaps as much as 15 inches.

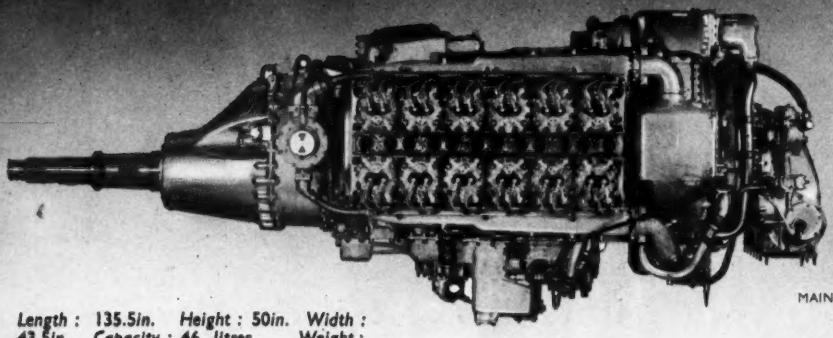
Detail Analysis

Now to consider the make-up of the engine in detail: we will start with the crankcase and work systematically from that foundation. The case is split vertically into port and starboard halves of cast light alloy—and a beautiful piece of work it is—with seven bearings for each crankshaft carried in lateral webs axially stiffened by integral intercostal bracing in each half. Lightening and pressure-balancing holes are formed in each web, and each crank chamber has two drain holes into the sump. The front end of the crankcase is double-walled with approximately a 2in cavity, the inner wall housing the No. 1 main bearings of each crankshaft, and the front wall carrying the tail bearings for the timing gears uniting the crankshafts.

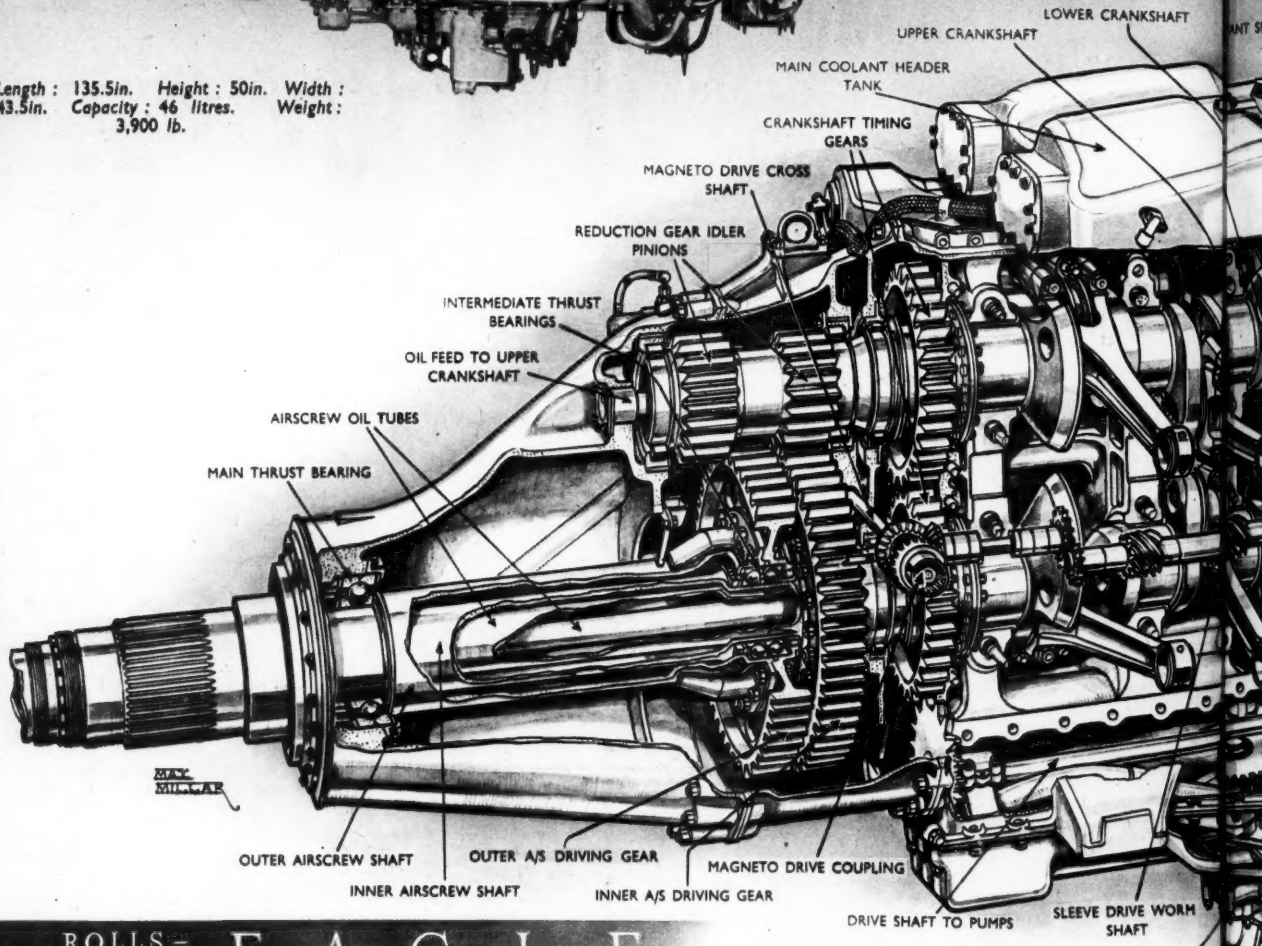
Cylinder blocks are also very fine examples of sand-casting technique in light alloy, the upper and lower rows of cylinders on each side being formed in one casting. Each cylinder is ventilated with three inlet and two exhaust ports, the latter ports of each vertical pair of cylinders discharging to a common pair of ejector stacks.

Sleeve drive is by a worm shaft on each side commonly serving top and bottom rows of sleeves, each shaft running in six split plain bearings. The bearing castings also incorporate the split plain bearings for the worm wheel spindles. The worm shafts are driven from their rear ends through





Length : 135.5in. Height : 50in. Width : 43.5in. Capacity : 46 litres. Weight : 3,900 lb.

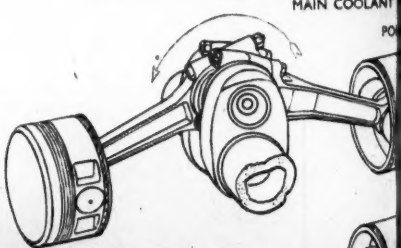


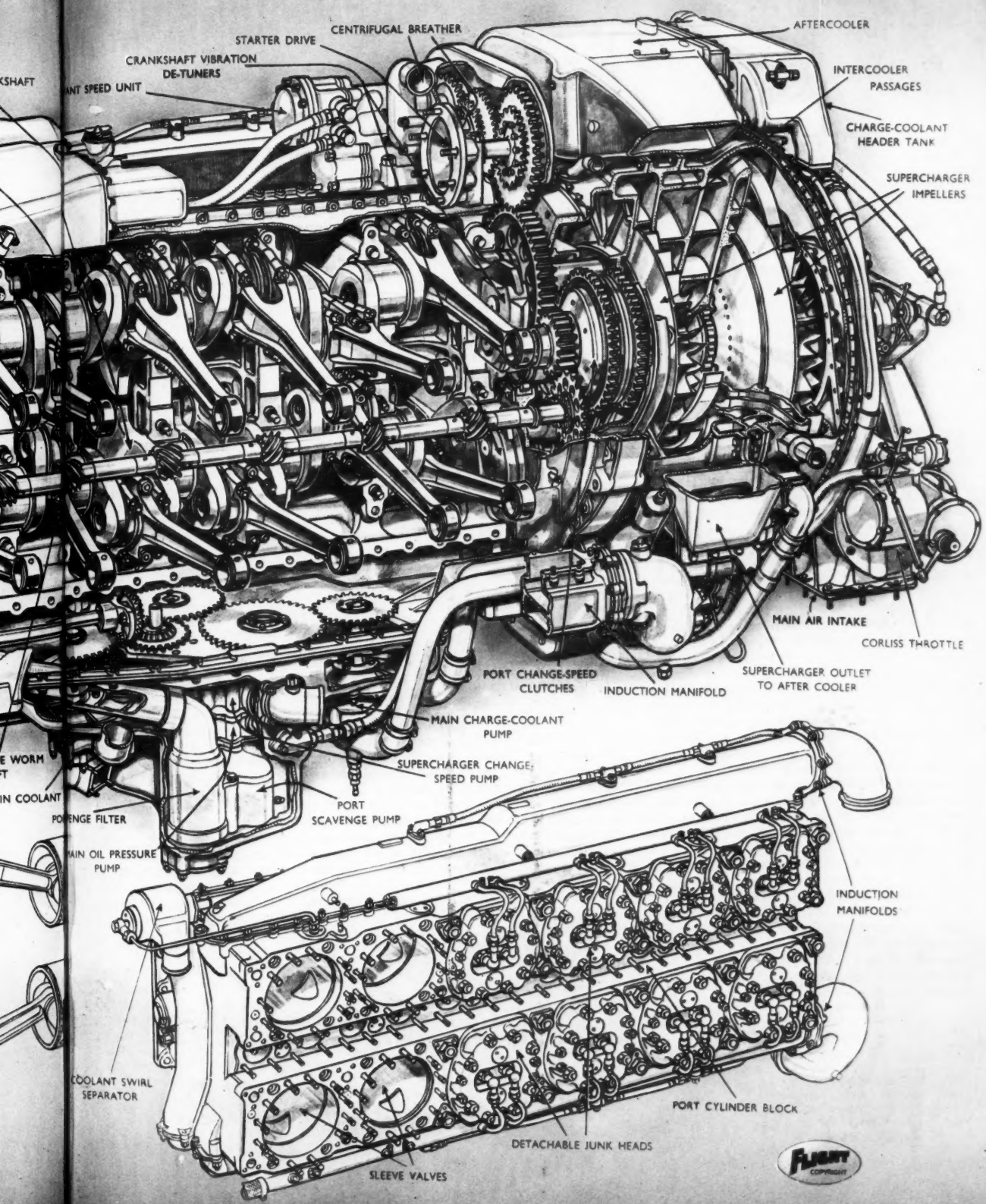
ROLLS-ROYCE EAGLE

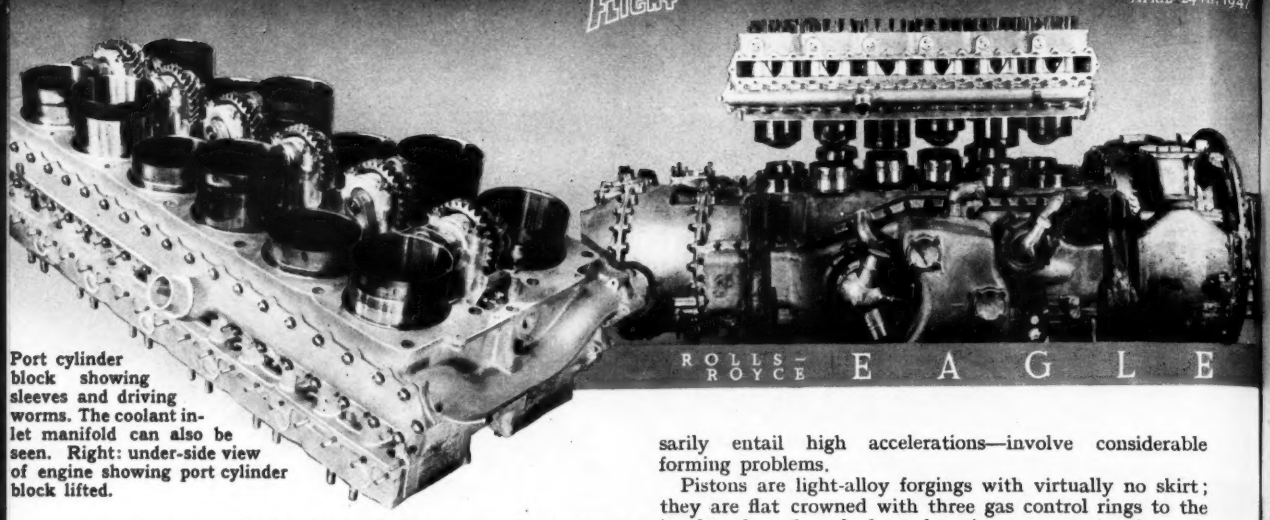
IN this special "Flight" drawing, the interior geography and detail layout of the Eagle are laid bare. The port cylinder block has been separated from the crankcase to enhance clarity, and the little-end centres of both rows of connecting rods are shown accurately positioned on their respective cylinder axes. Each induction manifold serving a row of six cylinders is divided through half its length. Thus each trio of cylinders is served, in effect, by its own manifold, the sectional area of which is progressively reduced for constant velocity flow.

The detail sketch of upper and lower adjacent pairs of pistons is taken from a frontal viewpoint, and in this sketch is summarized the fundamental concept of the engine. Drives from the crankshafts to the airscrew shafts can be followed by reference to the separate reduction gear detail, shown on a later page, but the division of subsidiary drives between front and rear sources is made admirably clear ; it should be noted, however, that the magnetos are driven from a transfer shaft off the port sleeve-drive worm-shaft which itself is driven from the rear of the engine.

It is also readily discernible that the extended housing forward of the reduction gear could, if required, easily be deleted and the overall length of the engine thus considerably reduced.




CENTRIFUGAL BREATHER
STARTER DRIVE
CRANKSHAFT VIBRATION DE-TUNERS
AFTERCOOLER
INTERCOOLER PASSAGES
CHARGE-COOLANT HEADER TANK
SUPERCHARGER IMPELLERS
MAIN AIR INTAKE
CORLISS THROTTLE
SUPERCHARGER OUTLET TO AFTER COOLER
INDUCTION MANIFOLD
PORT CHANGE-SPEED CLUTCHES
MAIN CHARGE-COOLANT PUMP
SUPERCHARGER CHANGE-SPEED PUMP
PORT SCAVENGE PUMP
INDUCTION MANIFOLDS
COOLANT SWIRL SEPARATOR
PORT CYLINDER BLOCK
DETACHABLE JUNK HEADS
SLEEVE VALVES

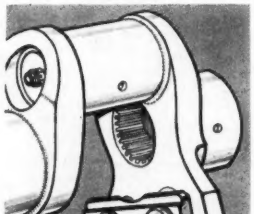


Port cylinder block showing sleeves and driving worms. The coolant inlet manifold can also be seen. Right: under-side view of engine showing port cylinder block lifted.

spur pinions, and the lead of the worms is arranged oppositely as between the front and rear trio in order to neutralize the end-thrust inevitable with skew gears.

All the junk heads are individual units of light alloy with domed flame crowns and with two gas control rings to the sleeves. Sparking plugs are of 14 mm "Long Tom" type, screwed into inserts in the crown, and each junk head is anchored to the block with eight major and four subsidiary studs.

The two crankshafts are essentially similar to those used in Griffon engines and are arranged to rotate in opposite directions, the upper shaft rotating clockwise viewed from the rear. Drive to the timing gears is by means of the well-tried R-R semi-floating coupling, and the blower drive incorporates the equally well-tried torsion spring coupling. A departure from previous practice lies in the use of vibration detuning masses, which take the form of channel-section arcuate segments fitting over the perimeters of the rear bearing counterweights. Each detuning mass is pierced by two bushed oversize holes in which register two pins, themselves riding in oversize holes through the counterweight. These detuners are designed on a variant of the Salomon principle and are intended primarily to cater for the $2\frac{1}{2}$ order of vibration, which they effectively damp out.



Detail of vibration de-tuning mass on rear web of each crankshaft.

Main bearings for each crankshaft are plain, split steel-backed lead-bronze shells with a flash of lead-indium. Connecting rods are conventional fork-and-blade pairs, the blade big-end riding on the o/d of the fork big-end, these bearings too being steel-backed lead-bronze shells. Little ends are lead-bronze alloy bushings, the diameter/bearing area ratio of which is greater than usual since, in effect, Griffon diameter gudgeon pins are used in pistons of Merlin bore size. Another somewhat unusual feature is that the gudgeon pins are retained with die-cast light alloy end caps: these were adopted, after investigation showed that they worked perfectly, in view of the fact that the more normal circlips when used with short-stroke engines—which necessarily entail high accelerations—involve considerable forming problems.

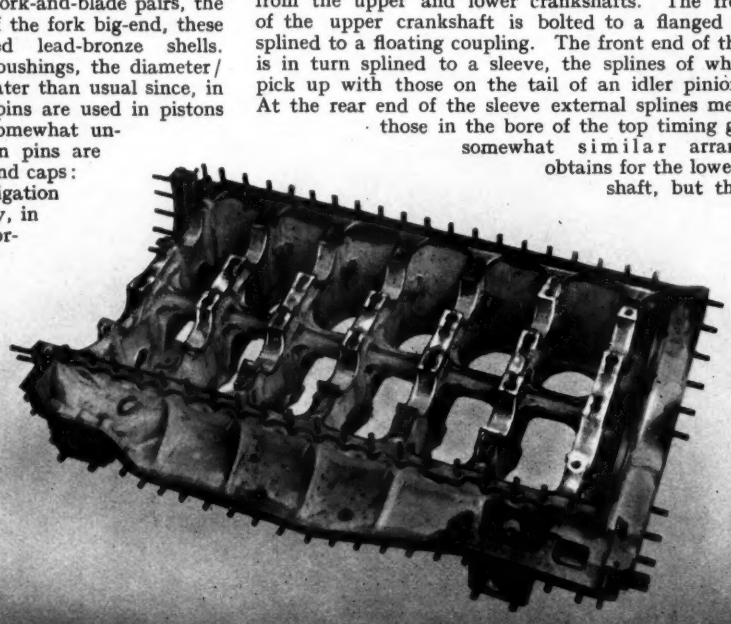
Pistons are light-alloy forgings with virtually no skirt; they are flat crowned with three gas control rings to the head and a pierced channel-section scraper ring beneath the gudgeon, there being just the bare minimum of material below the scraper to make its groove. Underhead finning is not used for these pistons, Rolls having come to the conclusion that, with reciprocating mass limitations, the volume of metal used in finning is put to better use when evenly distributed over the crown.

Block/sleeve sealing is achieved by one ring only, a trapezoidal-section scraper retained between crankcase and block around the sleeve skirt. Naturally, at bottom dead centre the sleeves protrude into the crankcase, the extent being about $3\frac{1}{2}$in. The pistons do not protrude from the sleeves at B.D.C. Each sleeve is pierced by four ports and thus, as each cylinder is ventilated by three inlet and two exhaust ports, two of the sleeve ports are inlet only, one sleeve port is exhaust only, and the fourth doubles alternately as inlet and exhaust.

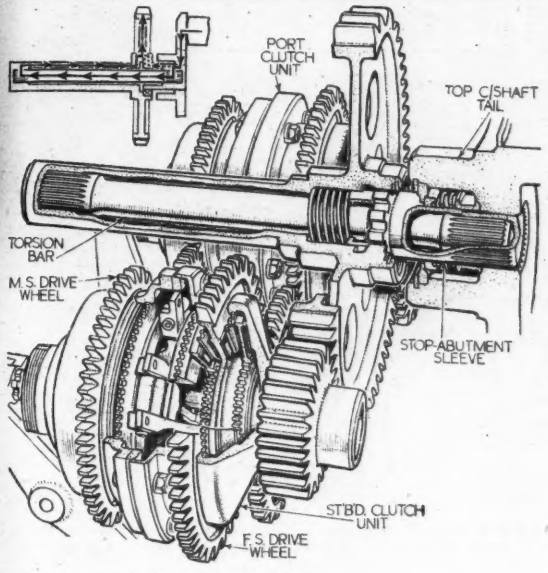
Reduction Gearing

Junk head/block union is metal-to-metal—with a jointing compound—and the two gas rings in the junk head bearing against the sleeve have their ends bridged to prevent splaying and, consequently, nibbling by passage of the sleeve ports. This detail, incidentally, is a proprietary design of the ring manufacturers.

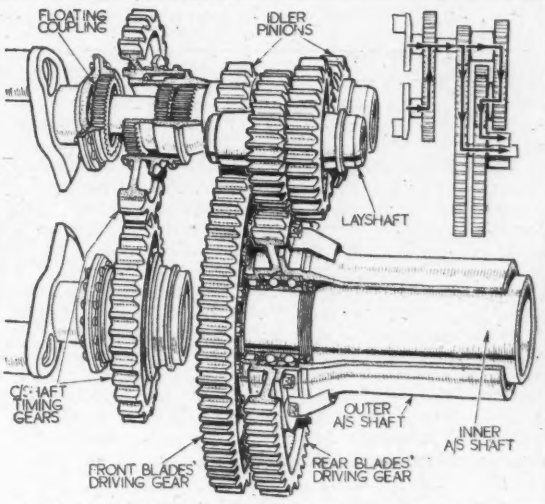
Power output from each of the "flat twelves" is unified in a pair of spur timing gears respectively taking the drives from the upper and lower crankshafts. The front end of the upper crankshaft is bolted to a flanged annulus splined to a floating coupling. The front end of the latter is in turn splined to a sleeve, the splines of which also pick up with those on the tail of an idler pinion shaft. At the rear end of the sleeve external splines mesh with those in the bore of the top timing gear. A somewhat similar arrangement obtains for the lower crankshaft, but the coup-



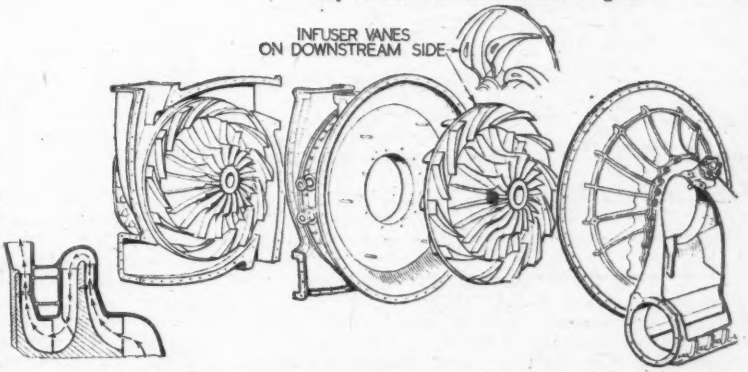
Port half-crankcase showing main bearing webs, inter-web bracing, and pressure-balancing vent holes. Note the double-walled front end.



Supercharger drive details showing arrangement of torsion spring coupling, spring-stops and clutches.



Detail of reduction gear showing how crankshafts' torque is unified and contra-rotation introduced. The drive paths may be traced in the schematic diagram.



Exploded sketch of supercharger main components. Gas flow path from the intake elbow through the blower and out to the aftercoolers is illustrated in the part-section detail at left.

ling is splined direct to the bore of the lower timing gear which, of course, meshes with the complementary upper unit.

The axis of the idler pinion shaft lies on the centre plane of the engine, with the concentric airscrew shafts immediately beneath. The driven gear of the inner airscrew shaft meshes direct with the rear pinion on the idler shaft, but the front idler pinion meshes with the front pinion of a layshaft offset to starboard and slightly below the axis of the idler shaft. The rear pinion on the layshaft meshes back with the driven gear of the outer airscrew shaft and thus is the drive taken as a common torque from both crankshafts, reduced in speed, and rotated in opposite directions.

Airscrew thrust is taken by a primary thrust bearing and two thrust-transfer bearings. The latter are identical, and are very large ball-type units mounted side by side with their inner races on the inner airscrew shaft and their outer races respectively housed in the outer airscrew driving wheel and the bore of the outer airscrew shaft. About halfway along this latter shaft is a buttress flange against the forward face which bears the inner race of the primary thrust bearing; the outer race of this bearing is carried in the front of the reduction gear nose casing. Also in the same housing, and immediately forward of the primary thrust bearing, is a roller bearing for steadying the outer shaft. The front steady bearing for the inner airscrew shaft is also a roller, but its outer race is housed within the hub driving centre of the rear airscrew which, of course, is carried on the outer airscrew shaft.

As previously noted sleeve drive is taken from the rear of the engine, but the forward end of the port sleeve-worm-shaft carries a small spur pinion which meshes with a spur wheel on the end of a forward extending shaft. This is splined to a bevel housed in the rear diaphragm of the reduction gear intermediate casing. The bevel drives a coupling and cross shaft (the latter carried in the cavity between the case diaphragms), these respectively driving the port and starboard magnetos.

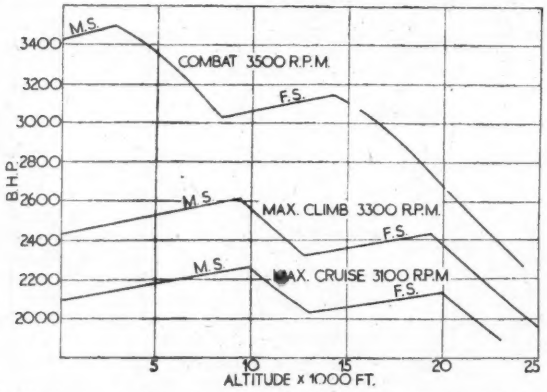
Meshing with the lower timing gear, beneath it, is a spur wheel on a rearward extending shaft, which terminates at a bevel in union with the master gear of the driving train for the massed pumps housed in the sump. These are as follows: the main coolant pump, which is of centrifugal type, mounted centrally in the forward end of the sump. Behind this and to port is a "tower" of three gear-type pumps, each housed in its own separate casing but all driven by the same shaft. These three pumps are respectively top, supercharger change-speed; centre, main oil pressure; bottom, port scavenge. Opposite the tower, to starboard, is the starboard scavenge pump—and incidentally it may be noted that filters for both scavenge pumps are incorporated with the casings. Rearward of the tower is the main charge-coolant pump, also of centrifugal type, and mounted to starboard at the rear end of the sump is the S.U. fuel injector pump of the type used so successfully on previous Rolls engines.

At the rear of the engine the drive to the two-speed, two-stage supercharger is taken only from the top crankshaft, a torsion coupling being used to relieve the crankshaft of shock loads from impeller inertia when undergoing rapid changes of speed. The bore of the upper crankshaft is internally splined to a sleeve carrying at its rear end seven abutment stops. The bore of this sleeve is internally splined to a torsion bar which, at its rear end, is in turn splined to an enclosing sleeve stalk integral with the spur wheel driving the pinions of the twin change-speed clutch units. The axes of these are disposed approxi-

ROLLS-ROYCE EAGLE

mately 100 deg on each side of the vertical centre plane through the engine, centring at the torsion coupling axis. Crankshaft drive to the supercharger is transmitted through the torsion spring, the abutment stops having a 10 deg clearance right and left to the complementary abutments inside the driving wheel. Thus when the torsion bar is wound up 10 deg either in accelerating or decelerating the drive becomes solid, but for ordinary constant-speed running the abutment stops are not in contact.

As units the clutches are pretty well identical with those on Griffon engines, but whereas the actuation of the flyweights in Griffon clutches is directly hydraulic, in the Eagle the change-speed unit valves oil from the pump (in the sump) to a ram unit in the base of the wheelcase diaphragm. This actuates toggle arms in the form of a yoke, the feet of which are each pivoted to a shaft carrying lands, and between the adjacent faces of these one arm of each flyweight registers. The drive from each clutch is alternatively (accordingly as moderate super-

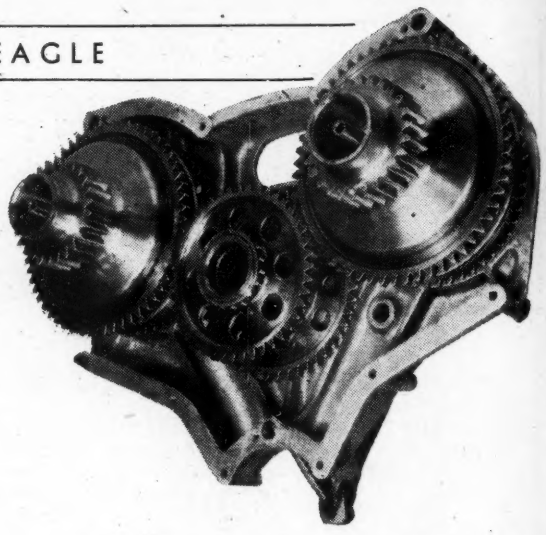


Maximum performance curves of power output against altitude for varying typical conditions. It is noteworthy that over 2,000 h.p. is available at cruising rating up to 20,000ft.

charge or full supercharge is required) but simultaneously given to a central pinion unit, the shaft of which carries two pinions respectively meshing with the MS and FS wheels of each clutch. The bore of the pinion shaft is splined to a further torsion shaft which transmits the drive to the shaft carrying the two impellers.

The impeller shaft is a single steel forging with a central land, to the end faces of which the impellers abut. Torque is transmitted through splines not unlike miniature versions of those on airscrew shafts, the impellers being retained on the shaft by sleeve nuts; the rear retaining nut is especially formed to throw off fuel from the injector nozzle and so promote atomization. Both impellers are light alloy forgings (although, naturally, of different diameters) with nineteen straight blades, but the rotor eye is formed by a ring of helically curved steel guide vanes also splined on the rotor shaft.

Discharge from the first-stage impeller is into a ring of twelve diffuser



Front view of twin clutch units in wheelcase showing how drive is given to the central pinion unit to which the impeller shaft is splined.

nozzles mounted on a dividing diaphragm which, on its opposite face, carries integral infuser vanes to the eye of the second-stage impeller. Discharge from this is likewise into a ring of twelve diffuser nozzles, and from these direct to the four tangential outlets leading to the four individual aftercoolers.

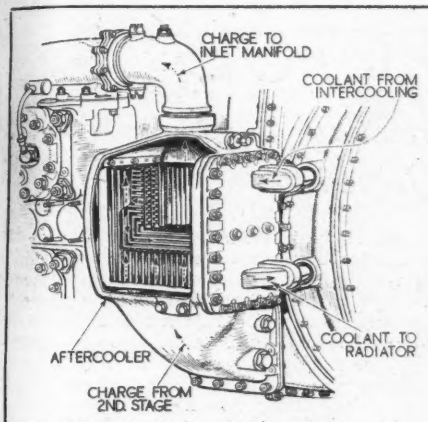
Reduced Throttle Loads

Main air intake is updraught past a Corliss type throttle, and so, via an elbow containing the injector nozzle, to the first-stage impeller. The intake mouth gives on to a drum chamber in which the throttle is axially pivoted, the intake throat thence tapering rapidly upward to the elbow. The Corliss throttle has been developed on Merlin and Griffon engines, on the later marks of which it has become standard. It has the advantage of reducing the control linkage loads and, for a given intake sectional area, gives some increase of aerodynamic efficiency. Linkage from the cockpit is taken to a toothed quadrantal segment which meshes with a small spur pinion on the port end of the throttle spindle.

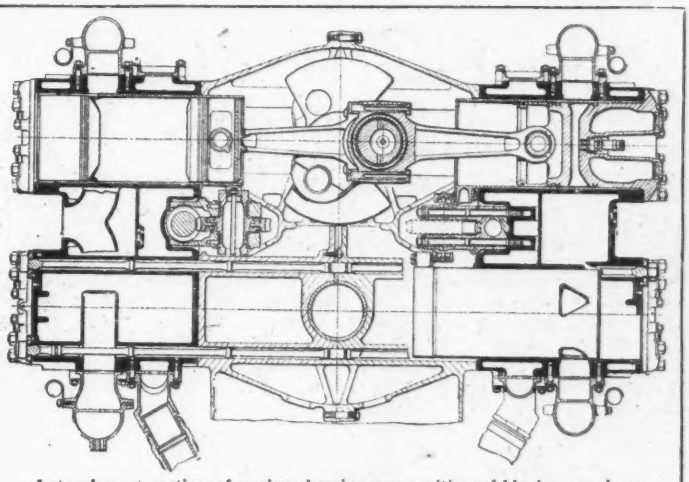
The elbow and intake unit—which includes the throttle—is mounted on the rear casing of the supercharger, in which the diffuser face for the first stage impeller is incorporated. This casing is flange-bolted to the intermediate casing and,

ROLLS-ROYCE EAGLE Mk. XXII

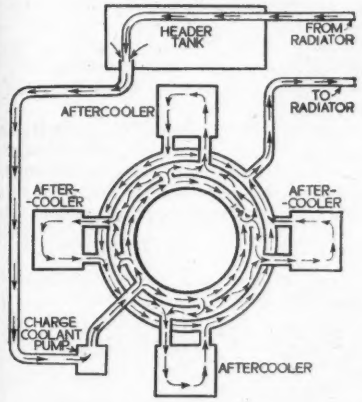
Bore and stroke	5.4in x 5.125in
Total swept volume	46 litres
Frontal area, actual	10.65 sq ft
Reduction ratio	0.2985, both shafts
Rotation	Inner shaft—anti-clock (viewed from rear) Outer shaft—clockwise (viewed from rear)
Airscrew shaft sizes	S.B.A.C., 5½, inner ; 7½, outer
Plug positions	Junk head well—horizontal axis
Firing order : two cyls simultaneously. A = stb'd top row ; B = port top row ; C = port bottom row ; D = stb'd bottom row.	1A and 6D ; 5B and 2C ; 4A and 3D ; 1B and 6C ; 2A and 5D ; 4B and 3C ; 6A and 1D ; 2B and 5C ; 3A and 4D, 6B and 1C ; 5A and 2D ; 3B and 4C.
Ignition timing	28 deg B.T.D.C.—both mags.
Main bearing diameters	3.454in
Main bearing areas	22.72 sq in centre, 20.6 sq in inter and ends
Big-end diameters	2.9035in fork rod, 3.518in blade rod
Big-end areas	25.08 sq in fork rod, 10.08 sq in blade rod
Gudgeon diameters	1.50in
Rod/gudgeon bearing area	2.10 sq in
Piston/gudgeon bearing area	3.83 sq in
Distance centre-to-centre of cyls.	6.90in
Con. rod length, centre-to-centre	10.250in
Max. angularity of con. rods	75 deg 31 min
Sleeve drive crank throw	1.275in
Valve timing	Inlet opens 43 deg BTDC, closes 60 deg ABDC. Exhaust opens, 60 deg BBDC, closes 43 deg ATDC
Inlet port area, total	5.85 sq in
Exhaust port area, total	3.9 sq in
Cylinder compression ratio	6.5 : 1
Max. internal comp. ratio of s/charger	4.18 : 1
Impeller diameters	19.5in 1st stage 17.0in 2nd stage
M.S. gear ratio	3.00 : 1
F.S. gear ratio	3.67 : 1
Rated height	9,500ft MS (at 12 lb/sq in boost, 3,300 r.p.m.) 19,500ft F.S. (at 12 lb/sq in boost, 3,300 r.p.m.)
Max. b.h.p.	3,500 at 2,750ft
Max. r.p.m.	3,500
Cruise r.p.m.	3,100
Max. cruise boost	9 lb/sq in
Max. b.m.e.p.	282 lb/sq in
Altitude to which 1 atm. manifold pressure is maintained	32,000ft at 3,100 r.p.m. FS.
Contract dry weight	3,900 lb
Power/weight ratio	0.8975 b.h.p./lb
Max. consumption	350 gall/hr at 14,250ft FS, combat
Take-off consumption	342 gall/hr at S.L.
Max. cruise consumption	142 gall/hr at S.L. in MS



Detail of aftercooler showing charge and coolant flow streams.



Lateral cross-section of engine showing composition of blocks, crankcase, manifolds and sleeve-drives. The relative compactness is admirably illustrated.



Schematic diagram of charge-coolant flow system for intercooling and aftercooling.

between them, is housed the diaphragm carrying the diffuser (upstream) and infuser (downstream) nozzles. In turn, the intermediate casing is flange-bolted to the front casing, and between the two are arranged the intercooling coolant passages. The supercharger front casing is through-bolted in common with the wheelcase to the rear flange of the crankcase.

Whilst on the subject we might examine the charge-cooling system which, as may have been gathered, embraces intercooling and aftercooling. The charge-coolant header tank is mounted immediately behind the top aftercooler, and serves the charge-coolant pump in the sump. This delivers to the inter-stage passages in the supercharger casing for intercooling. Coolant from the pump is taken to the innermost of three concentric annular passages formed between the casings. Flow is from the innermost passage out into the middle passage, where it is forced to take a tortuous path by virtue of a series of baffles, and thence is piped outward at four points to the aftercoolers. Having circulated through these the coolant then enters the outermost of the interstage passages whence it is ducted to the radiator, returning from that unit to the header tank. It may thus be seen that the intercooling flow is subsequently used as the abstraction medium for the final aftercooling of the charge before its delivery to the manifold.

Having touched on the induction cooling we might well survey the main coolant method which, known as a "shunt" system, differs from previous Rolls-Royce liquid-cooling practice. The header tank, which is mounted on four feet on top of the crankcase at the front end, is not a reservoir in quite the same fashion as previously understood. Starting from the main coolant pump, delivery is by separate pipes to the coolant manifolds beneath each lower row of cylinders, the flow thence circulating around the cylinders, junk heads and ports of the lower "six," then similarly circulates in the upper "six" and so out into the top manifold. At the forward end of each top manifold are swirl-type steam separators, the steam vent pipe from each being taken to the header tank, whilst the return pipe from each separator delivers straight to the radiator whence the main coolant pump is served. Thus the shunt system is virtually a closed circuit, the header tank merely supplying the system, as a reserve, through a small-bore pipe delivering to a venturi throat on the suction side of the pump. As coolant is expended a tendency to cavitation on the suction side of the pump naturally becomes manifest, and the pressure differential will induce flow from the header tank to recoup the system.

Ancillaries and Breathing

At the rear end of the engine, on top of the crankcase, is the ancillaries drive casing. On the port side of this is the primary shaft driven by a spur wheel meshing with the supercharger spring-drive gear. Carried on the primary shaft immediately forward of the primary wheel is a spur pinion meshing, to starboard, with the centrifugal breather drive, whilst at its front end the primary shaft carries a dogged coupling for starter engagement. The centrifugal breather driven-wheel carries in front of it a pinion which drives (again to starboard) the wheel of the auxiliary gear box coupling shaft. The latter carries at its forward end a spur wheel meshing both with the constant-speed unit coupling and the tachometer alternator coupling. The c.s.u. is mounted on the front face of the ancillaries drive casing—which forms the rear part of it—on the starboard side. The auxiliary gear box drive coupling is for attachment to a universal joint, the gear box itself being mounted separately behind the engine firewall.

Centrifugal breathing is a remarkably ingenious yet very simple system by means of which corrosive fumes are evacuated and oil retained. Essentially, the breather comprises a double-walled wheel of about 4½ inches diameter with spoke vanes dividing the interwall space into six pockets. At the base of each pocket is a drilling into the core of the hollow shaft on which the wheel is carried, the shaft core cavity being connected to a breather vent to atmosphere. The speed of rotation is calculatedly just sufficiently high to throw off oil by centrifugal force, yet not so high that air is thrown off in the same way, this being simply an exploitation of the difference in inertia between oil and air.

To conclude our appraisal, we can sum up the Eagle as being almost exactly what one would expect Rolls-Royce to produce, given the fundamental requirements. Implicit in this observation is everything that is associated with the maker's name.

EIGHT-BLADE ROTOL

Details of Latest Hydraulic Contra-rotating Airscrew: Stationary Cylinder and Sliding Piston

DESIGNED in conjunction with the Rolls-Royce Eagle—a detailed appraisal of which appears on the preceding pages—the latest, and largest, Rotol airscrew is an eight-blade contra-rotating unit which, with the Eagle, will be fitted to the Westland W/34 Wyvern. The new airscrew is the second of its kind to break with the Rotol operational precedent of a stationary piston and sliding cylinder, the first airscrew of the new type, i.e., with stationary cylinder and sliding piston, being designed for the Brabazon I; it was described in our December 26th, 1946, issue.

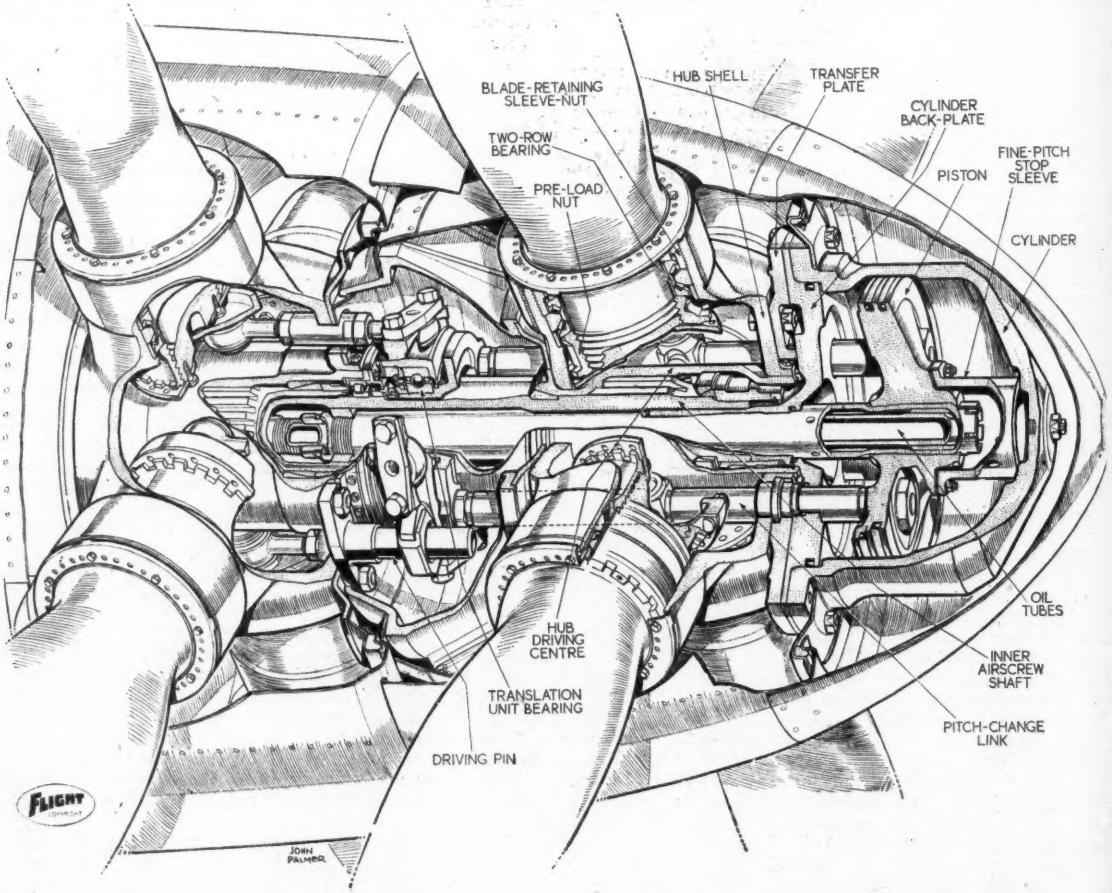
In order to take a step-by-step survey of the Wyvern-Eagle airscrew, the best course is to start with the airscrew shafts and then work through the several detail elements which make up the unit.

The concentric shafts are respectively S.B.A.C. 5½ inner and 7½ outer, and the two blade hubs are seated on the shafts in the conventional front-and-rear-cone manner, and retained by sleeve nuts screwed on the shaft ends. Torque is transmitted through the shaft splines to a driving centre which takes the form of an internally splined sleeve circumferentially bolted at each end to the hub shell.

Anchorage of the blades in the hub barrels is on a new principle. The blades themselves are fashioned as solid duralumin forgings, the root ends of which are machined to a shouldered parallel shank terminating with a run of threading for a steel sleeve nut. This retains a two-row Timken taper-roller bearing, which takes centrifugal and journal loads. The bearing is pre-loaded between the retaining nut and the blade root shoulder, an annular distance piece being interposed between the latter and the top race of the bearing. Location in the hub barrel is at the o/d of the centre bearing race, the blade being retained in the hub by a sleeve nut which, threaded in the barrel mouth, bears against the top surface of the centre race.

In major detail the rear hub is markedly similar to the front hub, although, of course, the driving centre is of larger bore to accommodate the greater size of the outer airscrew shaft.

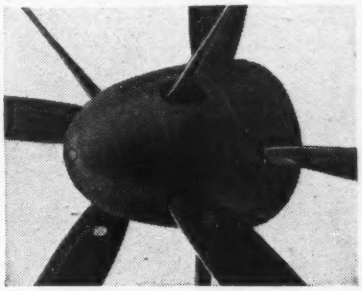
Housed in the bore of the inner airscrew shaft, at its front end, is the tail stalk of the cylinder back plate, the cylinder proper being flange-bolted to the back plate in common with an annular transfer plate, which itself is bolted to the front of the forward hub. Pitch-change motion is originated



In this special *Flight* drawing is graphically illustrated the detailed make-up of the latest Rotol contra-prop.

EIGHT-BLADE ROTOL

by movement of the piston inside the cylinder, actuating oil from the constant-speed unit being fed to the front and rear of the piston by means of concentric oil tubes carried in the bore of the inner airscrew shaft. The outer oil tube feeds fine-pitch oil to the rear of the piston, and the inner tube carries coarse-pitch oil to the front of the piston; thus the piston moves forward for fine-pitch motion and rearward for coarse-pitch. The fine-pitch stop is in the form of a sleeve flange-bolted to the front of the piston, its forward rim butting against the centre of the cylinder end wall; removal of this sleeve will permit the normal 35 deg pitch-range to be increased to 60 deg if required, to provide reverse-thrust braking. The coarse-pitch stop is arranged as a peripheral face on the rear side of the piston, which butts against the rear end-wall of the cylinder.



The relatively small hub size can be seen at right, whilst, above, the neat spinner is shown in place.

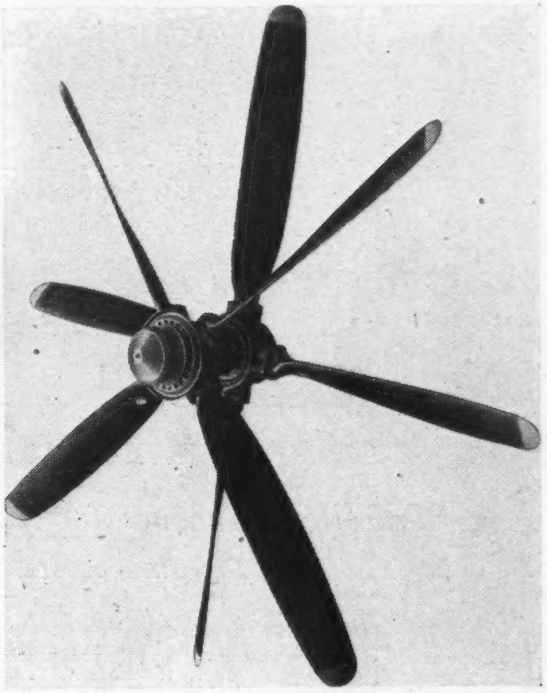
Movement of the piston is imparted to the blades on the front hub by means of four links anchored to the piston "web" and carried through the end-wall of the cylinder in Tufnol-bushed guides. These links each pick up to eyebolts, the "eye" of which accommodates a free Tufnol block laterally bored to receive the operating pin carried on the blade root. By this means the linear motion of the eyebolt is converted to arcuate motion of the operating pin. The rear ends of the front hub eyebolts are tapped for receiving the coupling links which pick up to the inner member of a translation bearing unit.

This unit is the means whereby the pitch-change motion of the linkage is transmitted from a source rotating in one direction to a destination rotating the opposite way. In essence, the unit can be summed up as a ball thrust bearing.

DATA

Diameter	13ft 0in
Pitch Range	35 deg (60 deg if required)
Basic pitch settings	25 deg 0 min, front 23 deg 30 min, rear
Rotation	L.H., front R.H., rear

The inner race of the translation bearing is retained on an annular sleeve member to which the coupling links from the front eyebolts attach. The outer race of the bearing is similarly retained in another annular sleeve member to which links for the rear hub eyebolts are articulated. In order to neutralize the effects of gyroscopic couple in rapid manœuvres of the aircraft, the rear coupling links are pivoted to the outer sleeve of the translation unit with spherical bushes and, similarly, the eyebolts are spherically pivoted to the operating pins of the rear blades.



To relieve the rear links of the necessity to drive the outer race of the translation bearing, the outer sleeve member carries a yoke into which fits a housing for a Tufnol spherical bush. A driving pin registers with the latter and, being bolted to the rear hub, transmits the necessary drive. The translation unit is enclosed by a truncated-cone shroud which is flange-bolted to an annular plate carried on the rear face of the front hub. Four inspection covers—one between each pair of blades—facilitate access to the pivot connections for the rear linkages.

THE ULTRA-LIGHTS

NOTHING could show more clearly the interest in low-powered flying than the fact, disclosed at the first annual meeting of the Ultra Light Aircraft Association, that this new body already counts no fewer than 206 members. The meeting was held at the R.Ae.C. Aviation Centre, Londonderry House, and it was known among members that the Whitney Straight committee which Lord Nathan has set up to advise him on private flying has recommended the revival of the pre-war "Permits to Fly" for small aircraft.

Mr. R. W. Clegg, who was re-elected Hon. Sec., presided over the meeting. The chairman of the Association has not yet been appointed, but a constitution was approved and the following sub-committee chairmen appointed: G/C. E. L. Mole (Design); Mr. H. N. Rose-Dale (Construction); Mr. R. S. Hogg (Inspection); Mr. A. D. Duncan (Registration and Insurance); F/O. I. G. Imray (Operations); Mr. Courtenay Edwards (Public Relations); Mr. M. O. Imray (Materials). Mr. Imray will act as Hon. Treasurer for the present.

Mr. R. H. Walmsley, Director of Aircraft Requirements at M.C.A., who attended in a private capacity, said that in connection with safety precautions three things were involved: control of design; supervision of construction; and flight testing. He thought it would be unwise for members to attempt to fly without these three stages having been passed to standards recognized either by some authority within the Association or by the A. R. B. itself. He also stressed the importance of adequate maintenance inspection.

Col. Preston, Secretary-General of the R.Ae.C., thought the Association might hope for considerable help from the Kemsley Fund, and the interest, on a basis of repayment over a period of 25 years, was only 5s per cent. He hoped the Association would establish its headquarters at Londonderry House, and promised every possible assistance.

Among the points raised was the need for a 40 h.p. British engine, and the possibility of preliminary instruction on ground trainers at low cost. Mr. E. O. Tips, of Avions Fairey at Gosselies, Belgium, is one of the newest members, and he is building a single-seater, Tipsy Junior, which may be available later in the form of prefabricated parts which could be assembled by members.

A telegram was sent to Lord Kemsley thanking him for his very practical help for private flying.

"Flight" photograph.

The *North Star* landing at London Airport on Wednesday of last week. After three hours on the ground it took off again on normal schedule to fly back to Montreal.

Travellers' Cheques for Air Travel : L.A.M.S. Start Air Tramp : Another Viking Tour

AIR TRAVEL PLAN

FOR the benefit of business travellers during the present difficult period of currency limitations the I.A.T.A. Traffic Committee has recommended a scheme for obtaining world-wide air passages on credit. The broad principle is similar to the British railway bulk travel voucher scheme and the bulk travel voucher scheme which was in operation before the war among the European airline members of I.A.T.A. This, however, earned a rebate of 20 per cent, but no such rebate is contemplated at present for the new travel plan. The issue of vouchers would be limited, owing to the present exchange restrictions, to three classifications: (1) for issue in, and restricted to travel in, the sterling clearance zone; (2) for issue in the sterling clearance zone and for travel in the dollar zone within a limit imposed by the exchange control of the sponsoring operator; (3) for issue in the dollar zone available for unrestricted use throughout the world.

Vouchers would be issued on request by airline members of I.A.T.A. to firms or individuals of sound financial standing. Operators would normally require a deposit, based perhaps on the estimated travel for a reasonable period, say two months, with a minimum of about £125 to $500. Vouchers when filled in and signed would take the form of a request to any I.A.T.A. airline company for any air passages required. Stages of journeys provided against transport vouchers by airlines other than the issuing operators would be cleared through the I.A.T.A. Clearing House, so enabling the issuing operators to charge the deposit account and the stage carriers to obtain their portion. In order to make these facilities available on internal routes in America, an agreement will be necessary with the Air Transport Association of the U.S.A., who already have such a scheme in operation. This arrangement would allow the I.A.T.A. plan to be honoured by all members of the American organization, and the A.T.A. travel plan to be honoured by members of the I.A.T.A. Clearing House.

NORTH STARS IN SERVICE

FOR three years Trans-Canada Air Lines have been flying converted Lancasters, with accommodation for ten passengers, across the North Atlantic, but on April 16th the first North Star landed at Heathrow to start a regular service four times a week with this new type. The company intend to run the service at this frequency with five aircraft, but as more become available so the frequency will increase to one each day in each direction, and North Stars will gradually be introduced on routes across Canada, the Pacific, and to America.

The aircraft which landed at London Airport last week was, in fact, a DC-4M Mark I, which is basically a Skymaster fitted with Merlin 620 engines and equipped internally to special T.C.A. requirements. Six aircraft of this Mark will be put into service, but they will be replaced eventually by the Mark II, which is pressurized. All the Mark I aircraft will then go to the R.C.A.F. as military transports. The DC-4M Mark II is the real outcome of the original ideas of Trans-Canada Air Lines for the best transport available at the present time using British and American products. The fuselage centre is DC-6, but 80 in shorter. The empennage and fuselage rear are DC-4, and the remainder of the aircraft is a mixture of DC-4 and C-54G, with the exception of the landing gear and fuselage nose section, which are DC-6. The power units are, of course, Rolls-Royce Merlin 620s. It is hoped that the first Mark II will fly on the transatlantic route some time in July.

Some trouble was experienced with noise, but baffle plates have now been fitted to deflect the exhaust on the inboard engines to prevent "drumming" on the fuselage. The operating figures are of some interest. Maximum cruising speed at 12,000ft, using 2,650 r.p.m. and 9 lb/sq in boost, is 302 m.p.h. The maximum cruising speed at 26,000 ft, using 2,850 r.p.m. and the same boost, is 326 m.p.h. The maximum range at 10,000ft has been found to be on test 3,975 miles, and at 23,000ft 3,840 miles.

The interior has been divided into two large compartments accommodating thirty-six passengers. The front cabin is equipped for normal seating with all passengers facing the same way, but the rear compartment has been designed as a lounge, enabling passengers to sit at leisure. The galley, providing storage room and cooking facilities, is amidships. There is a rest room for the crew immediately behind the flight deck and the navigation and radio compartments.

WORLD AIR TRAMP

DR. GRAHAM HUMBY, the managing director of London Aero and Motor Services, was due to leave Stansted yesterday on the first stage of a tramp around the world in one of the company's Haltons, *Port of Sydney*. The complete itinerary was arranged in advance and loads will be carried on each stage of the flight.

The route lies westward from Prestwick to Reykjavik and then on to Gander. The plan then is to fly via Montreal to La Guardia, and across the continent to San Francisco. After calling at several islands the tramp aircraft is due to call at Melbourne, Sydney, Brisbane and Darwin, and then strike north to Singapore and Rangoon. Two calls are to be made

CIVIL AVIATION NEWS

in India, at Calcutta and Karachi, and from there they will fly via Basra, Lydda and Malta to the U.K.

Dr. Humby is travelling as second pilot to Capt. Thiele, D.S.O., D.F.C., and the company's senior navigator and the chief ground engineer are travelling with an additional flight engineer and a wireless operator. Some spares are being carried.

L.A.M.S. have already made several long-distance charter flights this year. In March four flights were made to Belgrade, with full loads. From there the Haltons flew empty to Tunis, where loads of vegetables were picked up and brought to London. On one occasion in January Capt. K. Thiele took off from Heathrow at 2 o'clock in the morning and landed at Vienna at 7.30 a.m. Part of the load was taken off and the aircraft flew on to Belgrade, where the remaining load was left, and the aircraft landed at Heathrow by 8 o'clock the same evening. During March two charter flights were made to the Far East, one to Rangoon and the other to Bombay. The load on both occasions was 6,790 kilos.

SWEDISH TWIN : The S.A.A.B. company's Scandia, a 32-seater, flew for the first time last November. Cruising speed at 10,000ft is said to be 220 m.p.h. and the range, with full load, 1,120 miles. A successful tour of some of the European cities has just been completed.

COLONIAL CONFERENCE

THIRTY-EIGHT representatives from the Colonies met at Church House, Westminster, on April 14th, to discuss problems connected with the development of civil aviation in the various colonial territories. Representatives of various departments concerned in this country were also present. The Secretary of State for the Colonies opened the conference, and he was accompanied by the Minister of Civil Aviation.

Lord Nathan, in an introductory speech, emphasized that it was for the conference to discuss the best way in which the trunk routes could serve the British communities and to devise a pattern having regard to the layout of British territory across the world. Officers of the British Corporations at the conference included Major McCrindle and Mr. Maxwell from B.O.A.C., Mr. Brancker and Lord Amherst from B.E.A., and A.V-M. Bennett and Mr. Hough from B.S.A.A.

B.O.A.C. SERVICE TO CANADA

THE first B.O.A.C. commercial passenger service between the U.K. and Canada started on April 15th. The return ferry service, which has been in operation since the winter of 1941, is to continue with Liberators for the carriage of mail and freight and Corporation staff. The new service will be flown once weekly in each direction, through Prestwick and Gander, with Constellations. Departures from London will be in the evening on Tuesdays, arriving at Montreal on Wednesday afternoon. The total time for the journey will be 19½ hr. Departure from Montreal will be on Monday evenings, arriving at London on Tuesday afternoon, making a total journey time of 16 hr 45 min. Accommodation will be available for between twenty-eight and thirty passengers, depending upon the amount of cargo and mail carried, and fares from London to Montreal will be £77 10s single and £139 11s return. Passages can, of course, be booked to and from Prestwick.

ANNUAL LANDING FEES

LORD NATHAN took the opportunity at the Aerodrome Owners' Association dinner on April 14th, at the Dorchester, to announce the introduction of an annual landing fee system for private and club aircraft. A landing card, which would be obtainable at a rate for light aircraft of £5 per year, is to be, in effect, a season ticket admitting holders to land at those State-operated civil airfields which are open to private and club flying, free of further landing charges. Lord Nathan understood that the Aerodrome Owners' Association had approved a similar scheme for aircraft controlled by its members, and their season tickets would be known as blue cards as compared with the Air Ministry's red cards. The scheme has since been announced in *Notice to Airmen* No. 85.

Before Lord Nathan spoke, Mr. Whitney Straight, the retiring chairman of the Association, paid a tribute to the interest that the Ministry of Civil Aviation was taking in all branches of flying. Although many pre-war owners had now lost their airfields to the Ministry, he was sure that their interest would be maintained, especially in the case of municipalities. He hoped that the military authorities would again make use of private airfields for training in the R.A.F.V.R., and that charter flying would be given ample scope by the private owners. Private flying and model aircraft clubs were, he said, two of the most important activities which went to make the nation air-minded and which was so essential to air power. He was pleased that the Aerodrome Owners' Association had a seat on the N.C.A.C.C.

Lord Nathan said that there were 68 civil airfields open for use in the British Isles. Of these 35 were under State control and the remainder were under either private or municipal control. In addition some 40 Service airfields were open to civil aircraft in varying degrees. He hoped that more airfields would become available as time went on, but the requirements of agriculture and the shortage of labour and building materials were the limiting factors. A very important function remained to the municipality and private owners, however, for it was upon them that a strong, healthy and independent flying business could be founded for the non-scheduled operator and the flying club.

Private flying, he said, would demand small, well-organized, well-equipped air parks, and although he was not in a position to anticipate the report of Mr. Whitney Straight's Light Aircraft Committee, he felt that the need would not be for vast grass airfields but for air parks. These, he thought, might take the form of L-shaped grass runways with the clubhouse in the angle of the L, and the grass strips between 600 and 750 yards long. He hoped that by October this year, the occasion of the Silver Jubilee of the Itford meeting of 1922, it might be possible to launch some new plan for the rebirth of British light aircraft flying. The Minister concluded by saying that British civil aviation was more than just commercial air transport or just a manufacturing or operating industry. The air was now our national opportunity.

The new chairman, Alderman O. C. Purnell, proposed the toast of the guests, which included names too numerous to mention. Sir Frederick Handley Page responded. He was relieved, he said, to find that the Minister of Civil Aviation realized that his responsibility was not confined to the statutory Corporations, but to the entire field of civil aviation in this country. We must get away from the type of flying which could be compared with the motor racing track and develop flying which could be compared with country road motoring. He agreed with the idea of having aircraft which would require shorter runways. It was easier to design and put on the market a small aircraft than it was to design a small engine at a price at which it could be expected to be ordered. It must be appreciated, he said, that we must have cheap engines, and he made reference to the 43,000 private owners of aircraft in America. He did not consider that criticism mattered to

CIVIL AVIATION NEWS

aviation as long as people remained interested. It was the great enthusiasm and keenness of the people which meant so much. Mr. C. M. Newton thanked Mr. Whitney Straight for all he had done for the Association, and he, in reply, expressed his appreciation of the work done by Mr. Gillman, the secretary, during this rather difficult time since the war.

Alderman O. C. Purnell has represented Cardiff in the Association for many years. Mr. C. M. Newton has twice before been chairman of the Association, and has been a member of the executive committee from the start. He is manager of Sywell airfield, Northampton, and he and Alderman Purnell have represented the Association on many occasions and together visited the United States in 1944 to report on American airfields. The Association now has 92 members, of which 42 are municipal and 36 commercial. It is felt that if interest in airfields is revived the Association might re-start its pre-war programme of holding annual conferences at which papers of interest to owners were read, and also of organizing exhibitions of airfield equipment.

B.O.A.C. ENGINEERING SCHOOL

THE engineering section of the B.O.A.C. Central Training School, Aldermaston, was established at White Waltham, ex-A.T.A. headquarters, in 1945.

Some 250 men on courses lasting up to three months are at present under training, and they are drawn from demobilized Service ground engineers, aircraft and car factories, and also include men from B.O.A.C. bases for refresher courses. The basic standard is aimed at being a little above that of A.R.B., a large proportion of the students sitting for licences at the conclusion of each course.

Practical work is carried out in a large hangar divided into engine and airframe sections, and the theoretical side of the training is catered for by a large number of lecture rooms, and, in addition, a cinema.

W/C. M. D. Day, O.B.E., A.M.I.Mech.E., A.F.R.Ae.S., is principal of the school, and he is assisted by some forty-five instructors. The staff themselves keep up to date with current practice, the latest types of engines and developments in the industry by constant study in the technical information section of the school, and by visits to the Corporation bases, repair factories, and visits to manufacturers' works.

Training is divided into four phases: (1) basic workshop practice, this being common to both the aircraft and engine fitter, with classroom work, including arithmetic and geometry; (2) fundamental principles, at which phase engines and airframe fitters are divided into separate classes. An introduction is given at this stage to civil air legislation as it affects the work of fitters; (3) type course, in which detailed instruction is given on the type of aircraft, engines and equipment with which the fitter will be concerned; and (4) the pre-licence course, wherein the student is given instruction to enable him to sit for the A.R.B. examinations, these examinations being held at the school. There are, in addition, specialist courses for those men who are to specialize in instruments and electrical apparatus, the target being the aircraft engineer's licence category "X."

In order to determine the type of instruction to be given, new pupils are vetted by a selection board. The prospective pupil is examined orally and on paper, and he also states his previous experience. The selection board then assesses the type of training needed by the student.

The ultimate aim is to embrace apprentice training up to an establishment of approximately a hundred per annum for a five-year course. It will, in effect, be a boarding school, with all such an establishment's recreational facilities; in fact, somewhat akin to the R.A.F. system of apprentice training.

VIKING TOUR TO AUSTRALIA

WE announced briefly in *Flight* last week that a Viking had left on a demonstration tour of Australia and New Zealand. This tour follows on the successful demonstration which was made in South Africa recently and which resulted in an order from South African Airways. Mr. B. W. A. Dickson, who is in charge of the party, is a director of Vickers-Armstrongs and general manager of the aviation section. He is accompanied by W/C. Maurice Summers, sales manager. S/L. P. Robarts, is the pilot and the Viking is a standard Mark 1B long-nose 24-seater complete with the latest de-icing modifications.

On the way out they will call on Indian National Airways at Delhi, who already have a number of Vikings in service, and on the way back they intend to call upon Air-India at Bombay, who by that time will have received their first two or three Vikings. The opportunity will also be taken of showing the aircraft to interested parties in Malaya and the Dutch East Indies. More than 200 Vikings have now been ordered, of which approximately 70 have already been flown and of which many are already in service.

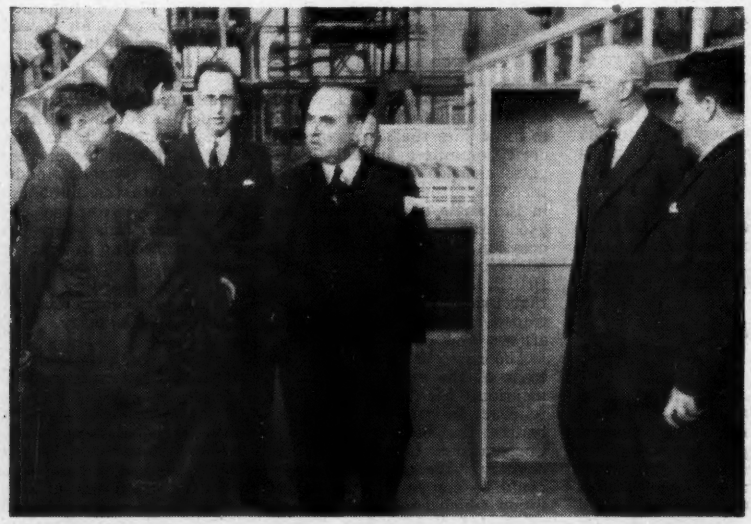
HEATHROW THROWS A PARTY

TO say that last Friday's "First International Air Ball," held at the London Airport, was not quite what its rather magniloquent title suggests does not imply that the name was inappropriate, for aircraft and crews of half a dozen nations do indeed operate in and out of Heathrow; and likewise there were accents other than English and American to be heard at the affair, which was in reality a party in the most sociable sense of the term, with nearly 700 people in varieties of civilian and uniform dress from white tie and tails to flannels.

Mr. Roper Pugh, the airport manager, wisely decided to initiate the event at the airport itself instead of at some West End *caravanserai*, and thereby preserved the essential atmosphere; cars were parked by mobile floodlight and the roar of aircraft running-up on the tarmac filled in the band intervals.

Guests included the Minister of Civil Aviation, Lord Nathan, Air Chief Marshal Bowhill, Chief Aeronautical Adviser to the Ministry of Civil Aviation, and A. V-M. Bennett.

Mr. H. C. Godfrey, secretary of the organizing committee, must expect an avalanche of applications when the celebration is repeated.



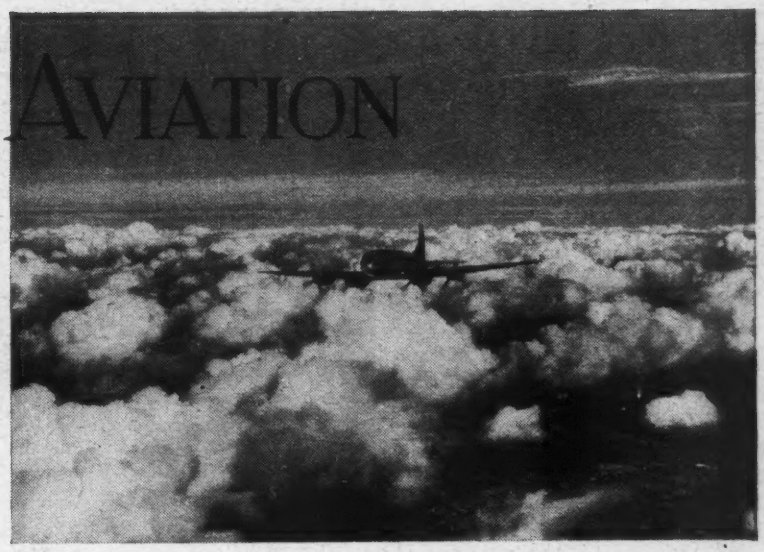
BRISTOL VISIT: Lord Nathan was greatly impressed with progress on the Bristol 167 on the occasion of his recent visit. The photograph was taken immediately after his inspection of the aircraft and shows from left to right: Mr. A. E. Russell, chief designer of the Bristol Aeroplane Co.; Mr. W. R. Verdon-Smith; Mr. Peter Masefield; Lord Nathan; Mr. C. F. Uwins and Mr. H. J. Pollard, general manager of Bristol's.

A.R.B. NOTICE

THE Air Registration Board have issued *Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft No. 16.* The *Notice* refers to certain surplus aircraft equipment which is being offered for sale by unapproved firms and owing to dump storage is, in some cases, unserviceable. Owners are warned that unless equipment has been previously certified by an appropriately licensed engineer or an approved firm the C. of A. of the aircraft, to which such items are fitted, will be invalidated.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements



HIGH ENDEAVOUR: Precursor of the promising *Hermes* civil air liners, the first prototype of the Handley-Page Hastings C.1 military transport is seen on a test climb from its manufacturer's airfield at Radlett.

Appointments

THE Air Ministry announces that A. V-M. S. E. Toomer has been appointed Air Officer in Charge of Administration, Technical Training Command. A. Cdre. A. Gray is to be Air Officer Commanding, Air Headquarters, Iraq, with the acting rank of Air Vice-Marshal.

A. V-M. Toomer, who is 52, has been Air Officer Commanding No. 205 Group, Mediterranean and Middle East Command, since March, 1946. He was Director of Fighter Operations at the Air Ministry in November, 1943.

A. V-M. Gray, who is 50, has been Director of Flying Training at the Air Ministry since February, 1945.

R.N.V.R. Squadrons

FOUR R.N.V.R. Air Squadrons are to be formed. Three will be located in the areas of Glasgow, Liverpool-Manchester and London-Oxford. The location of the fourth will be announced shortly. The squadrons will be commanded by R.N.V.R. or R.N.V.R. (A) officers and will have liaison with the existing R.N.V.R. divisions but will be independent commands.

For the present, enrolment will be restricted to pilot and observer officers between the ages of 20 and 30 who have had front-line squadron flying experience with the Royal Navy. Officers who have held command of front-line squadrons may be accepted up to the age of 33. A small number of air engineer officers will also be accepted up to the age of 35.

Pilots and observers will be eligible to enrol for an initial period of five years, which may be extended subject to certain stipulations. Air engineer officers will not be required to enrol for any specified period. Pilot and observer officers will be required to carry out annually fourteen days' training either ashore or afloat, twelve week-ends and a further hundred hours' non-continuous training. They will be eligible for a bounty of £35 per annum and all officers will be entitled to full Naval pay and allowances during continuous training periods. For evening and week-end training an allowance of 1s 6d an hour and 1s-1s 2d per mile will be payable.

ARCTIC ADAPTABILITY: A Gloster Meteor III (two Rolls-Royce Derwent) undergoing winterization trials at Namao, Alberta, Edmonton, Canada. When the photograph was taken (February this year) the ground temperature was — 40 deg. C.

New Zealand Mosquitoes

THE eighty Mosquitoes ordered by the New Zealand Government as post-war equipment for the R.N.Z.A.F. are arriving at Ohakea, in ones and twos. The first squadron to be equipped will be No. 75. (The title of this wartime N.Z. heavy bomber squadron has been transferred to the former No. 3 G.R. Squadron, the first N.Z. squadron in action in the Solomons). Some of the Mosquitoes are being flown from Pershore by R.A.F. ferry crews, and some by No. 75 Squadron crews, who were ferried to Britain in Dakotas of 41 Squadron, R.N.Z.A.F.

There has been criticism of the Government in New Zealand for buying aircraft which the critics claim are now obsolescent, and the argument is raised that if the Mosquitoes are merely stop-gap equipment, till jet development is carried further, then the Lend-Lease Venturas, which, after equipping R.N.Z.A.F. bomber squadrons in the Pacific, now lie wasting away in long rows on Rukahia airfield, Hamilton, might just as well have been used.

In reply the Minister of Defence has said that the Mosquitoes are not stop-gap equipment, but will remain standard for some years. New Zealand needs a long-range attack machine.

The R.A.F. and the Floods

IN the Fens and the Thames Valley, assistance continues to be given by the R.A.F. to the river catchment boards and local authorities in their efforts to deal with flood damage. Six R.A.F. pre-heater vans, designed for warming aircraft engines, have been at work in the Maidenhead area, drying-out houses and furniture by means of hot air, and other pre-heater vans are doing similar services in the Windsor and Eton area.

A good deal of R.A.F. equipment has been sent to the Fens, where the most urgent tasks are to pump the land dry and to dry out the houses. R.A.F. personnel are also assisting the Dutch engineers and others who are dealing with the two breaches in the banks of the river Trent in Lincolnshire.

Much of this work has to be carried on by night, and the Service is providing

SERVICE AVIATION

flood lighting, including a number of small searchlights mounted on tenders. R.A.F. mobile cranes have also been sent to assist the engineers in the Fens, whose work has been greatly facilitated by tracks of Somerfield wire netting (normally used for the improvisation of airfield runways) laid by the R.A.F. Other tracks, constructed with railway sleepers, have also been laid by the Service.

Biggin Hill Officers' Dinner Club

IT is proposed to form an Officers' Dinner Club for R.A.F. officers who served at, or with Squadrons or units controlled by, Biggin Hill between September 3rd, 1939, and October 31st, 1940. Any serving or retired officer who is interested should communicate with the Joint Honorary Secretary, enclosing a stamped addressed envelope for reply.

Missions to Far East and Africa

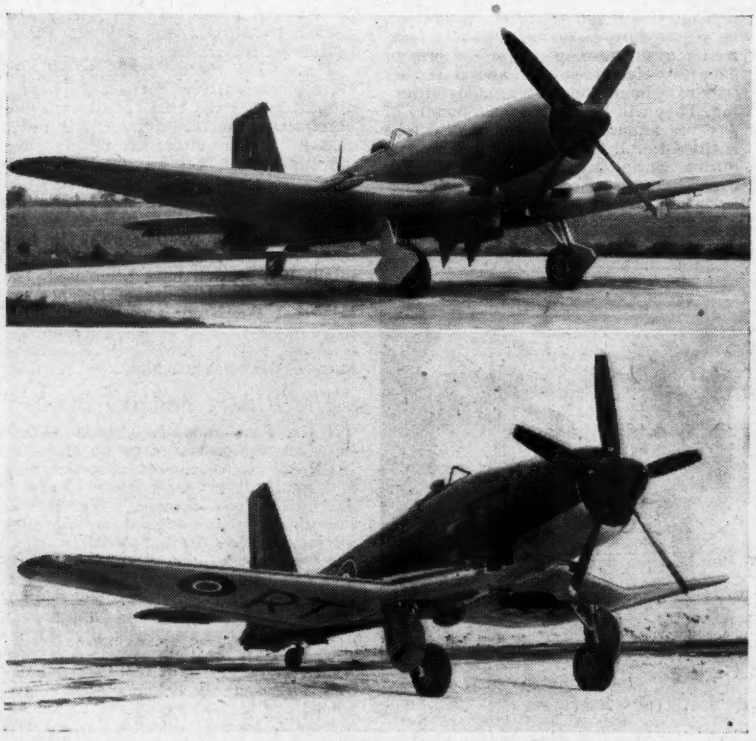
TWO R.A.F. liaison missions are planned to leave on April 27th and April 30th. The first—to the Far East—is to be undertaken by the Empire Air Armament School, R.A.F. Manby, using a Lincoln Mk II (*Thor II*). The latest armament devices will be demonstrated, and discussions will be held on current armament problems.

The second will be undertaken by *Aries II*, another Lincoln Mk II, which has just concluded a flight to the Far East, and which belongs to the Empire Air Navigation School, R.A.F. Shawbury. The itinerary for this flight will include South and East Africa and Rhodesia. It is proposed to spend fourteen days with the South African Air Force.

ARRIVAL AT NORTHOLT: General J. L. Proliet, Chief of the French Air Force, inspecting the R.A.F. guard of honour on his arrival at Northolt last Monday week.

Meteor T. Mk VII

THE dual-control trainer version of the Gloster Meteor IV fighter has been officially designated Meteor T. Mk VII. Deliveries will start next year. The second seat is below the level of the normal pilot's seat and is fitted where the ammunition is usually stowed.



A STEP FURTHER: In *Flight* of February 13th this year appeared a set of photographs illustrating the development of the Blackburn Firebrand. The comparative views above show how the new Y.A.1 differs from the Firebrand V.

A.T.C. Camps

EVERY cadet in the A.T.C. will this year spend seven days at a "holiday camp" organized by the R.A.F. The first four of these opened at Easter, and by summer there will be eighty in operation at R.A.F. and Naval Air Stations all over the United Kingdom.

An extensive programme has been planned for the cadets, including flying and gliding, lectures on many R.A.F. subjects, and sports and swimming. There will also be talks by Service pilots, as well as concerts, sing-songs and film shows.

In addition the A.T.C. will join in the everyday activities of the station. They may be asked to refuel aircraft, lay out a flare-path, or take a turn in the control tower.

The seven largest camps, capable of accommodating up to 300 cadets, will be at Manston (Kent), Valley (Anglesey), Driffield (Yorks), Chivenor (Devon), Thorney Island (Hants), Turnhouse (near Edinburgh) and Aldergrove (Northern Ireland).

Reunions

A REUNION dinner, for officers who served at the Headquarters, stations and units of No. 206 Group, R.A.F. Middle East, will be held at the Holborn Restaurant, London, W.C.2, on June 6th, 1947. Assemble 18.00 hours for dinner at 19.00 hours. Dress: uniform, dinner jacket or lounge suit. Price 17s per person. Cheques, made payable to "No. 206 Group Reunion Dinner," should be forwarded by May 15th to G/C. B. L. Blofeld, Air Ministry (P.6), London, W.C.2.

* * *

A reunion dinner will be held at The Connaught Rooms on June 2nd for all officers who served at 3 T.A.F. 221 Group and H.Q.s 14 Army: L. of C. Comd. S.E.A.C. Apply, remitting 25s., to Lt. Col. Turner, 518, Kensington Close, W.8. Number of R.A.F. personnel limited to thirty.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

MOBILE TEST BEDS

Up to Take-off Speed ?

I DISAGREE with your statement that the B.O.A.C. mobile engine test house allows "the complete elimination of the need for air testing."

Admirable and useful as it may be, it cannot prove such things as the adjustment of maximum r.p.m. at take-off or those elusive loss of power reports with all ground boost and rev readings spot on.

It should not be forgotten that the engine is not "on load" while static, and unless the test house is mobile up to take-off speeds (happy thought), I for one wouldn't feel inclined to sign on the dotted line. P. FYFE MAURITZ.

INFRA-RED

Drawbacks to Use as Landing Aid

REPLYING to your correspondent, H. J. Manners, in the issue of April 10th may I, as one who has worked on infra-red equipment through the war years, correct one or two misapprehensions that seem to be fairly general on this subject?

First, the work in this country in no way lagged behind that of Germany and America, though it had little publicity.

Secondly, the type of infra-red equipment referred to by Mr. Manners operates on the "near infra-red"; that is, infra-red just beyond the visible spectrum, and in consequence has negligible fog penetrating qualities. Infra-red rays that will penetrate fog are confined to a fairly narrow waveband, and while instruments exist for their detection, in their present state of development they do not present the observer with a detailed extended visual image.

Thirdly, the authorities in this country are fully aware of the potentialities, capabilities and, unfortunately, its very serious limitations as an aircraft landing aid.

Finally, with present sources of infra-red radiation, the searchlight in the nose of the aircraft would have to be of enormous power and weight to give adequate range, and in any case the pilot would be completely dazzled by "back glare" due to reflection of a large proportion of the infra-red by the fog.

The suggestion of infra-red lamps on the runway, while not new by any means, is the more practical, but in any case it must await the further development, which promises to be very lengthy, of suitable long wavelength infra-red vision equipment. G. S. P. FREEMAN.

AIRCRAFT LANDING

Bad Weather Technique Advocated

AMONG the voluminous correspondence produced in the last few months on the subject of "Aircraft Safety," I consider that the letter in *Flight* of February 6th, 1947, by Graeme Percival, under the heading "Radio Beam Flying, a dangerous attitude of indifference," to be nearer the truth than any of the others, since the one basic fact on which all the others depend is the mental attitude of the pilot. It has always been a source of wonderment to me that while everything connected with an aircraft is stressed, constructed and tested with the worst possible situation in mind, the pilot invariably manœuvres his aircraft to land by a technique which is entirely a fair-weather one. Moreover, his whole training is based on that fair-weather method, and his technique of arrival when the weather is bad is added almost as an afterthought.

Some fifteen years ago the production of the standard instrument panel made two things possible. The first was that anybody could fly accurately instead of the few experts; and the other was that you could do it without looking out of the aircraft at all. The whole concept of pilotage changed, or rather it should have done. Since then the development of bad-weather flying has been hindered by a retention of standards which no longer mattered, by laziness, but above all by lack of decision. As a result of that retardation we are now faced with the problem of "landing capacity," a problem which would have solved itself by now if bad-weather flying had been developed in line with our progress in other respects. To add to our troubles we are now in the position of having so many aids that we are spoilt for choice, and we have no definite method for using any of them. Finally, the Press has exalted radar into being the logical successor to St. Christopher, and the public are confused and bewildered by the whole business. And well they might be.

The immediate step in the solution of this bad-weather flying problem, therefore, is to bring the pilotage of aircraft in line with design and adopt a technique of landing which is geared to the worst possible, and not to the favourable, conditions. The use of a circuit or approach by external observation must be forbidden when passengers are carried, and every approach must be made by instrument. Nothing less will do. It is an unfortunate fact that we cannot put on a different technique, as we do a mackintosh, when the weather is bad, and there are some melancholy facts which prove it, yet, as your correspondent points out, pilots avoid "pulling down the blinds" if it is at all possible and will persist in looking out. Even those that conscientiously do their Link and I.F. practices only resort to the use of them as a last resort.

It seems to me then that there are two possibilities:—

(1) The "Master" sits up at the front and emulates the "Master" of a ship. Give him a telescope if you like to add the right atmosphere. He can take the aircraft off and take it over to complete the landing when the approach has been made to 100ft. Otherwise he does nothing but make decisions and the aircraft is manœuvred at all times by a "Coxswain" who is in a seat from which he can't look out, preferably somewhere in the bowels. He must have a full set of controls, "George" and an instrument panel.

(2) The Captain flies the aircraft as he does now, except that as he approaches the airfield he is screened. He is provided with a competent look-out whose sole duty is to avoid collisions with uncontrolled aircraft and to "raise the blind" at 100ft on the approach.

In each case I specify 100ft as the point to look up, for there won't be many occasions on which you can't land from there and this is not a paper on blind landings. It is to point out what I consider to be the least effective weapon in our armoury. I suppose the battle between civil aviation and the weather will finally be won by an automatic landing device, and such a thing is probably possible now, but I will guarantee it is ten years before it is marketable. Meanwhile the battle is on and we are losing it. G. E. LILLYWHITE (S/Ldr.).

ROCKET ENGINES

Fuel Mixing and Delivery

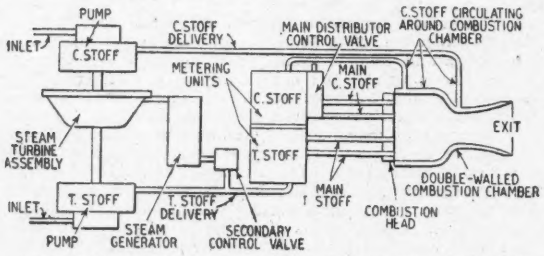
WITH reference to the article on Rocket Engines, on pages 231 and 232 of *Flight* (March 20th), the line diagram shown in the top half of the illustration at bottom left of page 231 is misleading. This deals with the Walter H.W.K. 109-509 rocket engine fitted to the Messerschmitt Me163B.

Your diagram shows mixing of the C. Stoff and T. Stoff in the double walls of the combustion chamber. If this occurred in reality spontaneous combustion would occur with disastrous results to the combustion chamber. Also your line diagram shows the main distributor control valve as being interposed between the T. Stoff main supply and the double walls of the combustion chamber. The main distributor control valve is situated on the main C. Stoff supply lines to the combustion head. There is a secondary control valve which is interconnected with the main control valve. This determines the quantity of T. Stoff being passed from the T. Stoff pump delivery to the catalysts in the steam generator. As the main control valve is opened so is the secondary control valve and the supply of T. Stoff to the steam generator is increased. The increase in available steam gives a greater rotational speed to the turbine wheel, greater delivery from the pumps, and so increased supply of the bi-fuels to the combustion head. The diagram on the next page illustrates the layout.

The T. Stoff consists of hydrogen peroxide 80 per cent and water 20 per cent. The C. Stoff consists of methanol (methyl alcohol) 57 per cent, hydrazine hydrate 30 per cent, and water 13 per cent. These mixtures are fed to their respective pumps —the T. Stoff to the right-hand pump, and the C. Stoff to the left-hand pump. The C. Stoff passes to the double walls of the combustion chamber and acts as a coolant, thence back to the metering unit and through to the main distributor control valve. From here it passes directly to the combustion head through spray nozzles. The T. Stoff supply passes from its pump to the metering unit (the pressure of the C. Stoff regulates the amount passed through this unit) and thence directly to the combustion head through spray nozzles. The C. Stoff and the T. Stoff intermingle at this point, and due to

CORRESPONDENCE

the addition of small quantities of potassium cuprocyanide which acts as a catalyst, spontaneous combustion occurs. The burning gases pass into the combustion chamber and then expand through a venturi exit to the outside air.



Part of the T. Stoff pump delivery is passed via the interconnected secondary control valve to the steam generator. Here it passes over a catalyst consisting of porous stones impregnated with calcium permanganate and potassium chromate and is converted into steam. The steam is led to the nozzle of the steam turbine, driving the turbine wheel and thus the delivery pumps. Should the turbine wheel rotational speed become excessive the delivery pressure from the C. Stoff pump is led to a rubber diaphragm and acts on this against the pressure of a spring. This depresses a valve in the secondary control valve unit so restricting the supply of T. Stoff being used to generate steam. As the steam supply diminishes, so does the rotational speed of the turbine wheel diminish and the pumps' delivery with it. The valve in the secondary control valve unit then returns to normal. When the main distributor control valve is closed it is the T. Stoff pressure which moves this controlling valve in the opposite direction once more restricting the steam generated and slowing down the turbine and pumps. A pressure lead is also taken from the main distributor control valve to the rubber diaphragm to provide adequate control of pump speed.

The main difference betwen the Walter H.W.K. 109-509 A.1 and the 109-509 C. is in the starting mechanism. The A.1 rocket engine utilizes an electric starter motor for initial turning of the turbine wheel and pumps. The "C" rocket engine utilizes a T. Stoff starter with ejector valves which exhaust the air from the pumps. There is a secondary combustion chamber for cruising conditions.

Empire Central Flying School. RUPERT F. SIMMS, F/S.

JET BOMBERS
Author Vindicated

IN *Flight* of July 18th last year the Douglas XB-43 was described by Mr. H. F. King in his article on Jet Bombers as an adaptation of the piston-engined XB-42 "Mixmaster." Writing from New York, Mr. Christopher Clarkson was not slow to contradict this, adding that it would be fairer to say that the XB-42 was an adaptation of the "43."

The author's defence of his original contention evoked from a correspondent, signing himself "Test Pilot" (and whom I suspect is a very famous one indeed), the affirmation that, by virture of his service in the U.S.A., Mr. Clarkson's knowledge should be second to none, and describing as "unkind" the manner in which Mr. Clarkson had been "shot down in flames."

I have no intention of re-opening the correspondence, though it was instructive more than vindictive, but I would refer Mr. Clarkson and "Test Pilot" to an article by Mr. Carlos Wood, chief of Douglas's preliminary design section, in the *Aeronautical Engineering Review* of January this year. Here Mr. Wood, whose pronouncement must surely be final, unequivocally describes the XB-43 as a development of the XB-42 and presents a mass of material which proves that, far from being a mere prototype of the jet machine, as suggested by Mr. Clarkson, the Mixmaster was designed and built to meet a very real operational need. "LOYAL SUBJECT."

DELAY IN AWARDS
Complaint from Australia

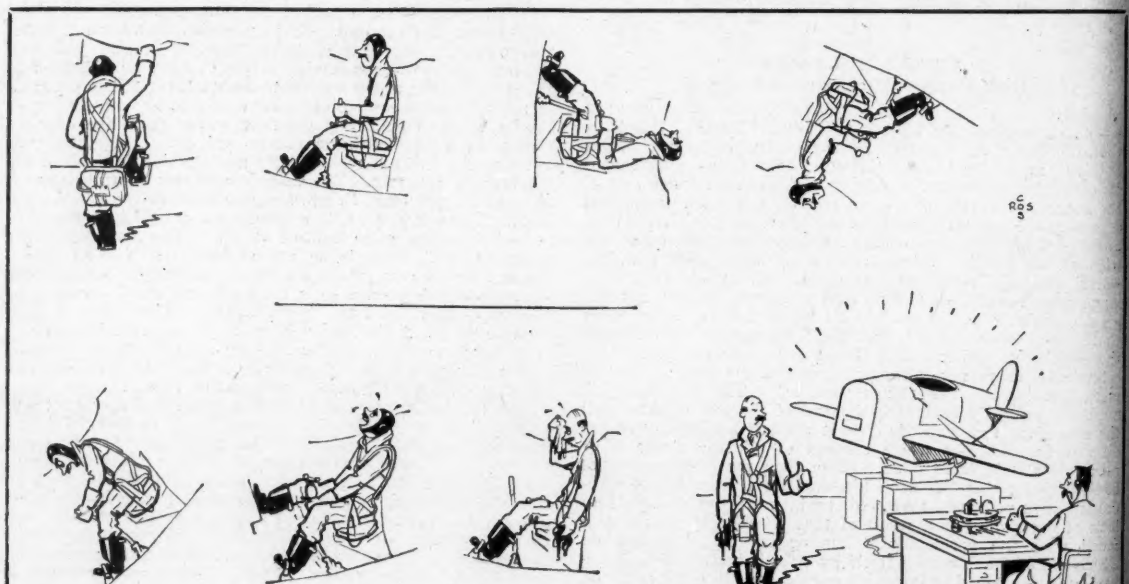
SEVERAL letters in copies of *Flight* recently reaching us here have criticized the delay in presenting decorations. The position is the same in Australia, my brothers and I served with No. 103 Squadron R.A.F. and we are still waiting for some sign of our awards. Maybe the mails are too crowded to allow them to be posted.

D. A. HENRY, R.A.A.F., F/L.

113 A.G. Hospital, New South Wales.

[Aircrew due for awards are referred to *Flight*, October 10th, 1946, page 408, in which we published a statement to the effect that His Majesty deeply regretted his inability to present awards to each recipient personally (there are some 55,000 still outstanding), but that a personal letter would be sent with each decoration delivered by post. Application must, therefore, be made giving name, Service number, rank, decoration and address to which the decoration is to be sent. These details must be forwarded to the Under Secretary of State, Air Ministry (S7(d)), Adastral House, London, W.C.2.—ED.]

If the reader who signs himself "Air Traffic Control Officer, Grade III" will send his name and address (not for publication) we will consider publication of his contribution.—ED.



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